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Egyptian Nuclear Nonproliferation:

The Politics of a Weak State

by

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Major, United States Army
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EXECUTIVE SUMMARY

While Egypt had motivation and capability to go nuclear in the 1952-1981 period, it failed to do so because of the structural weakness of the state. Fearing the creation of a political "power center" within the state elite, the regime undermined the very agencies it created to obtain nuclear weapons. Conventional nuclear proliferation literature does not explain why Egypt did not "go nuclear". To all outward appearances Egypt was strongly motivated and technically as capable as other states (in 1955) which did eventually achieve nuclear weapons - Israel, India and Pakistan. The historical case of Egypt's nuclear non-proliferation under Presidents Nasir and Sadat can be largely explained by the model of weak states. This is a departure from conventional international relations theoretical explanations for what restrains or obstructs a state from acquiring nuclear weapons.

The three conventional models for explaining the processes of nuclear proliferation and nonproliferation are the motivational imperative, the technological imperative, and the idiosyncratic occurrence. According to the motivational model, Egypt possessed the motivational factors to produce a nuclear explosive device by 1965 and was prevented from doing so by scientific and financial shortfalls. The motivational model establishes that Egypt met the necessary condition of motive by 1961. But it does not explain why Nasir fired a strong nuclear-weapon-proponent directing the Egyptian program, Colonel Salah Hedayat, at the time when Egypt suspected Israel was only three years away from producing a bomb, and afterwards attempted to buy the bomb directly from the Soviet Union.

According to the technological model, the international and

bilateral embargoes of weapons-production technology requests prevented Egypt from acquiring the know-how to manufacture the facilities to produce a nuclear weapon. According to the technological model, Egypt possessed sufficient initial scientific interest in 1952 to have achieved latent technical capacity to build a bomb by 1970. The technological model explains that because Egypt never developed the necessary scientific and technical expertise or the ability to profitably extract available natural resources, the program faltered. Egypt's case is often explained as never developing the technology because of the investment capital deficit. This explanation is insufficient. Donald MacKenzie's comparative-politics variant of the technological model, that successful technological change is dependent upon a proponent scientist's manipulation of existing economic constraints and political constraints, might show that Egypt did develop the scientific organization, but that organization was not able to persuade the leadership of the feasibility of military applications. MacKenzie's model cannot be proven with available information. The technological model does not explain Egypt's advanced scientific base despite technology embargoes. Egyptian scientists have succeeded in directing other nuclear weapons programs such as the Iraqi one.

My use of the weak state model applied to nuclear weapons proliferation proposes that structural political weakness is the determining factor of a state's inability to develop nuclear weapons. The existing regime fears the political mobilization of the nuclear science community and its potential coalition with military cliques, or other power centers, to overthrow the regime. The leader faces a dilemma of choosing between changing domestic priorities and international security priorities. The regime indirectly prevents the maturation of a bomb program by fostering institutional instability, coopting scientific directors, retiring politically unreliable weapons proponents, and under-budgeting the program. Comparative politics literature has established modern Egypt as a classic case of a weak state governing a strong society. Other potential nuclear weapons states which are structurally weak states are: Mexico, Syria and Saudi Arabia. Modern Iran and North Korea are strong states. Egypt's structural-political weakness has continued or worsened in the last fifteen years, therefore weak-state politics will continue to obstruct a weapons development program.

Weak state comparative politics theory provides an explanatory model where existing nuclear non-proliferation motivational theory, technological theory, and some idiosyncratic models, are inadequate to explain given conditions. Nuclear weapons motives and nuclear weapons technology remain necessary conditions for the years-long process of developing states attempts to go nuclear, however the necessary and sufficient condition is that the developing state be a structurally strong state. That is, the state must be able to extract resources from society and be able to enact regime policies so that society complies with state rules. The ruling regime must consolidate its power enough so it does not fear a "palace coup". A strong state will not fear the domestic political threat of an atomic science community allied with a political party in opposition to the regime.

United States nuclear nonproliferation policies can positively influence both a strong state's nuclear weapons motives and a weak state's level of nuclear technology. American or international nuclear restraints should be so directed. The domestic security threat of a nuclear science organization must be evaluated on a case-by-case basis for each potential nuclear weapon state. Domestic politics is the decisive factor of a weak state's success or failure in developing nuclear weapons.

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I. INTRODUCTION

What explains the absence of nuclear proliferation where motive and capability are clearly evident? Why would a state with significant industrial and scientific bases, which has initiated a nuclear program and which is engaged in a military and political struggle with an enemy it knows is developing nuclear weapons, seek to undermine its own nuclear program?

Drawing on the case of Egypt from 1952 to 1981, this thesis seeks to explain nuclear nonproliferation by looking at the structure and consolidation of state power. Weak states - those with extractive and implemental structures unable to adequately perform their tasks - will tend to have regimes not only unable to carry out the social transformations they sought, but afraid of creating power centers within state structures which could threaten the political survival of the regime itself. Given the dilemma of pursuing significant policy choices such as acquiring nuclear weapons, which can create centers of power beyond the ability of a regime to control, and thereby risking political survival, weak states will undermine the very agencies they created to carry out such policy goals.

According to international security conditions and initial science development in 1952, Egypt should have acquired nuclear weapons by 1970. Egypt's leaders tried to develop nuclear weapons before Israel obtained them. In 1953 Egypt initiated a strategic rocket development program. The Egyptian Atomic Energy Establishment was formed in 1955. In 1961 Egypt possessed an operating research reactor. The regime invested heavily in a cobalt-60-warhead rocket program from 1960-1963. Egypt attempted to buy nuclear weapons directly twice, first from the USSR in

1965 and then from the Peoples Republic of China in 1967.[1] Throughout this period Egyptian leaders suspected Israel of developing an atomic bomb. The newspapers first confirmed Israel's capacity to make an atomic weapon and to deliver it by long range ballistic missile in July 1970.[2] Why did Egypt not develop some limited nuclear weapons capability during a continuous Egyptian-Israeli armed rivalry[3] before acceding to join the Nuclear Nonproliferation Treaty (NPT) in 1981?

The Egyptian-Israeli nuclear arms race occurred from 1955 to 1981. Egyptian leaders knew of the enemy capacity, directed a project of their own, fought wars against that enemy, and even developed chemical weapons, but hampered the progress of its own nuclear weapons program repeatedly throughout this period. Why? What explains the absence of nuclear proliferation where motive and capability are clearly evident?

A. NUCLEAR NONPROLIFERATION IN DEVELOPING STATES

Existing international relations models of nonproliferation do not satisfactorily explain why Egypt did not develop a nuclear weapons capability by 1981. I submit that the theory of weak states provides a more consistent explanation of the contradictions apparent in the Egyptian nuclear development program.[4] This study is the first use of the previously established weak state model to explain why a motivated and capable state did not develop nuclear weapons. In this case, the appearance of nuclear proliferation camouflaged a weak state leader's control of potential threats from within the regime. That appearance of developing nuclear weapons, whether intended or unintended, provided two political benefits for the leader: (1) towards the state's external allies and rivals, a credible threat of investment in weapons technology, and (2) towards the scientific pro-nuclear community, restraint of a potential challenge to mobilize opposition against the regime. Egypt's failure to acquire nuclear weapons from 1955 to 1981 is directly due to the political weakness of the authoritarian regime, not technical constraints or changing motives.

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[1] Hedrick Smith, "Soviet Said to Offer Cairo Atom Defense," New York Times, 4 February 1966, pp 1,12; Mohammed Heikal, The Cairo Documents, New York: Doubleday & Company, 1973, pp 305, 313; Shyam Bhatia, Nuclear Rivals in the Middle East, New York: Routledge, 1988 p 56.

[2] Hedrick Smith, "US Assumes the Israelis Have A-Bomb or Its Parts," New York Times, 18 July 1970, pp 1,8.

[3] This rivalry included four wars (1948, 1956, 1967, 1973) and periods of state-supported violence less than war (fedayeen attacks from 1953-1956, and the war of attrition from 1967-1970).

[4] While the "state-strength" comparative politics literature is vast, I have chosen to use Joel S. Migdal's, Strong Societies and Weak States, (Princeton: Princeton University Press, 1988) as primary reference. This work is the best

Conventional explanations for why a state does not succeed in developing nuclear weapons neglect domestic political issues which are especially important in developing states. The interactive relationship between domestic politics and international security hampers developing states' external security. A developing state can experience points in time when domestic priorities and international priorities are synchronized to support a nuclear weapons program. Sometimes these priorities conflict with "going nuclear." At times the boundaries between foreign and domestic security become blurred. Most nuclear non-proliferation literature focuses on changing motives to acquire nuclear weapons and restraining nuclear scientific capabilities. The dissuasive motivational explanations or the scientific technology hurdles only partially explain why Egypt did not complete the development of an atomic bomb. International security motivations and scientific capabilities are necessary but not sufficient conditions for nuclear

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accounting of the political dynamic I use to explain states' attempts, or lack thereof, to acquire nuclear weapons.

proliferation. The third condition which is both necessary and sufficient is that a state must be a strong state, politically able to extract resources, enforce regulatory compliance and execute political policy decisions, in order to go nuclear.

I examine the reports available in open literature, regarding Egypt's nuclear development program, from 1952 to 1981. During the period when the Egyptian leadership was publicly committed to matching Israel's suspected nuclear capability, the leadership intermittently undermined the indigenous development program. Rather than making a consistent long-range investment in nuclear technology, President Gamal Abd al-Nasir attempted to buy the technology covertly in 1965 and again, after losing a war, in 1967. It was this political weakness and not international nuclear nonproliferation pressure, nor technological backwardness, which restrained a capable and motivated state from developing nuclear weapons. Egyptian scientific and technological capabilities initially encouraged the leadership's decision to obtain nuclear arms. Later, after significant progress, the leader of the Atomic Energy Establishment threatened to ally with potential rivals to the regime within the state party (the Arab Socialist Union) and the army. The leadership initially tried to acquire nuclear weapons, but later favored other, less politically-threatening, conventional and chemical weapons. The Egyptian government's commitment to nuclear weapons acquisition during this period of armed rivalry with Israel waxed and waned with the confidence of the authoritarian leader in his support. From 1956 to 1964 and again from 1973 to 1975, the leader was confident in his support from regime elites. If the government had consistently supported the scientists after 1956, the state probably could have developed nuclear weapon technology before 1981 as Israel did. The theory of weak states explains the government agency appointments, "retirement" of politically dangerous proponents to innocuous posts in the government, budget allocations, and frequent reorganizations and fragmentation of the Egyptian nuclear science community.

B. WEAK-STATE HYPOTHESIS

Only strong states can go nuclear. Given the necessary conditions of security motive and basic scientific capability, the necessary and sufficient condition for a state to develop its own nuclear weapons is that it be a strong state. A strong state is defined by its ability to extract resources from and execute policy decisions over its society. A security-motivated and scientifically-capable weak state faces the domestic political dilemma of either: (1) fully supporting the scientific community's development of nuclear weapons, with the expected gains in international power, but risking that the scientific community may ally with a coalition to overthrow the regime[5], or (2) actively opposing the scientific community's development of nuclear weapons, thereby losing prestige within the regime elites and risking the same anti-regime coalition. A weak state will bounce back and forth between these two courses unintentionally as a by product of attempts to remain in power. International security and domestic security priorities may periodically support a nuclear weapons program, but they are more often contradictory, one supporting and the other opposing a nuclear weapons program. By political learning, the leader arrives at the safest course of action - allowing the scientific community to proceed with the nuclear development project and interfering with that same project when it threatens to mobilize opposition to the regime, or when it just gets more power than it should have.

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[5] Either the scientific community itself may become politically active or the political representative overseeing the scientific community.

If the weak state leader can insulate the atomic energy development community from such political competition and bureaucratic budgetary rivalry, he may support the project consistently, but at considerable risk of a domestic coup. As long as the military is assured of its position within the regime, it will support the development of nuclear weapons. The military leadership will oppose going nuclear if that means loss of military influence over the regime and gain of influence over the regime by an extra-military domestic coalition. The scientific community becomes a potential coalition party while it is developing an advanced technology with both civilian and military applications. The weak state must coopt or disrupt the scientific community in order to preempt political threats to the regime.

C. ORDER OF THE STUDY

This case study is limited to the period from 1952 to 1981 for five reasons. First, this is the period of heightened international rivalry when Egypt's motives to acquire nuclear weapons are strongest. Second, this period includes times of varying nuclear technology export controls, from the relatively open access of the 1954 Atoms for Peace period to the restrictions of the London (Nuclear) Suppliers Group export controls in the middle 1970's. Third, Egypt joined the international nonproliferation regime by ratifying the Nuclear Nonproliferation Treaty in February 1981, seemingly quitting the nuclear arms race with Israel. After that time, Egypt's motives for acquiring nuclear weapons significantly decreased. Fourth, this period typifies the stage that a newly formed, post-colonial "underdeveloped" state experiences during attempts at industrial modernization. This stage will be repeated many times over as so-called "third-world states" modernize. Fifth, the political relationship of state and society during these two regimes, including the transition between them, were characterized by narrow constituencies and varying degrees of popular support and political participation. Nasir rode a decreasing wave of popular support and Sadat constantly battled for popular support. The acquired popular support was ephemeral for both Nasir and Sadat.

The military character of the regime during this period implies that this model applies to any other military-supported regimes. That is not the cased. Some military-supported regimes are strong states, as were North Korea and the Soviet Union during their atomic development programs. Military regimes formed during wars of liberation or as a result of war exhibit characteristics of strong states. However many military-supported regimes in developing countries are examples of weak states. Turkey and Syria are examples of this.

The order of the study follows. The first chapter gives a general review of existing nonproliferation literature and then introduces the weak states model for studying nuclear proliferation. The second chapter examines Egypt's nuclear development program from 1952 to 1981. The third chapter analyzes the Egyptian case in terms of the weak state model. Here I compare my original explanation with the traditional explanations for why Egypt did not acquire nuclear weapons. The fourth chapter suggests implications and generalizations from this case history, which may apply to other aspiring nuclear weapons states. Additionally this section suggests implications of the weak state model on U.S. nuclear nonproliferation policy.

II. EXISTING LITERATURE REVIEW

Three general themes are usually found in efforts to explain the path toward nuclear proliferation: the motivational imperative (intentions determine the result), the technological imperative (capabilities determine the result) and the idiosyncratic occurrence (a unique sequence of events not dominated by capabilities or intentions).[1] The following summaries are representative of the existing literature on nuclear proliferation. They are given here to provide a context for the political model of weak states with strong societies.

A. INTERNATIONAL RELATIONS MODELS

1. Motivational Imperative

Stephen Meyer's quantitative analysis of capabilities and intentions supports the motivational imperative: state leadership intentions are the key component in explaining the years-long process of acquiring nuclear weapons. Technical limitations can slow the proliferation process but state motivations are the key to all decisions whether or not to "go nuclear". Meyer demonstrates no clear correlation between technology and nuclear proliferation. His argument supports technology as a necessary but not sufficient condition for nuclear proliferation. The key explanatory variable is the motivational profile of the state, which historically has differed from state to state.[2]

According to Meyer, three basic categories of incentives motivate or dissuade a state leadership towards a nuclear weapons program: domestic politics, military security, and international power or prestige.[3] The range of possible motivations and dissuasive conditions affecting the decision to acquire nuclear technology and to make nuclear bombs is listed below.[4]

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[1] Meyer, op. cit., pp 9-18.

[2] Ibid., pp 165-166.

These motives and dissuasive factors affect decisions to cancel funding for the program, continue domestic latent technology development, test a peaceful explosion, or to produce weapons. Egypt's motives and dissuasive factors are selected from this list in th econcluding section. To state the obvious, determining whether a motive of dissuasive condition existed at all at a point in history is a subjective judgement. Then determining the relative strength of the motives and disincentives is purely arbitrary. The evaluation process is given to normative bias. The difficulty in comparing motives does not negate their presence. Motivation must be included, albeit vaguely defined, as a necessary condition for proliferation.

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[3] Ibid., p 46.

[4] Ibid., pp 44-74. These motives are: (1) security threat from nuclear-armed adversary, (2) adversary with latent nuclear arms capacity, (3) overwhelming conventional military threat, (4) regional power status or pretensions, (5) uncertain state existence (pariah state), (6) quest for military superiority, (7) deterring regional intervention by a superpower, (8) global power status or pretensions (9) domestic turmoil opposing the regime (10) industrial spinoffs, (11) low military institutional morale (12) neighboring states' possession of nuclear weapons (13) intolerably high economic defense burden, (14) loss in alliance credibility with a nuclear ally, (15) general global trend toward acquiring nuclear weapons, (16) global increase in nuclear weapons inventory. Dissuasive factors are: (1) nuclear ally's security guarantee, (2) preemptive intervention by global powers, (3) international legal commitments, (4) peaceful reputation, (5) rival with latent capacity (fear of nuclear arms race) (6) risk of unauthorized seizure, (7) domestic politics. Craig and Jungerman (Nuclear Arms Race: Technology and Society, New York: McGraw Hill, 1990, p 438) include the following dissuasive factors: (8) strategic credibility gap (non-utility of nuclear weapons), (9) absence of foreign threat, (10) political-economic sanctions, (11) public opinion, and (12) domestic bureaucratic competition.

2. Other International-Relations Based Sources

Mitchell Reiss defines nuclear proliferation as a function of technological capability and political motivation.[5] He analyzes the effectiveness of the non-proliferation regime in obstructing six technologically capable states from producing nuclear weapons (Sweden, South Korea, Japan, and India) or publicly acknowledging their nuclear weapons status (Israel and South Africa). This study emphasizes the motivational perspective and concludes that four "sources of restraint" provided just enough friction to prevent the state from either producing the weapons or publicly admitting that fact. Those restraints are (1) domestic political opposition, (2) bilateral foreign policy pressures, (3) international non-proliferation measures, and (4) a general international consensus against nuclear weapons. The author admits to the weakness of proving these last two restraints in the case histories surveyed. He recommends a non-proliferation policy which strengthens each of these restraints.

Stockholm International Peace Research Institute prepared a motivational-based analysis of nuclear non-proliferation in preparation for the 1985 NPT Review Conference.[6] The purpose of this book was to show the motives and dissuasive factors in each of fifteen state's acquisition of nuclear technology and their decisions whether or not to join the NPT. This study is dated by its choice of Israel in the case studies. The editor concludes that a concert of international measures can successfully block proliferation if they are tailored to each state's proliferation motivations.

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[5] Mitchell Reiss, Without the Bomb: The Politics of Nuclear Nonproliferation, New York: Columbia University Press, 1988, pp 248-269.

[6] Jozef Goldblat, editor, Non-proliferation: The Why and the Wherefore, London: Taylor and Francis, 1985.

Shyam Bhatia argues that intentions will overcome technological limitations in future cases of nuclear proliferation in the middle east.[7] This source is one of the more detailed case studies available in the public domain. He reviews the proliferation histories of six states: Israel, Egypt, Libya, Iraq, Iran and Pakistan. He concludes that both Israel's early commitment to nuclear weapons and western encouragement of commercial applications created strong motivations for proliferation in the middle east. The author implies that the reason that Israel and Pakistan succeeded in developing the capability to produce nuclear weapons was a combination of unofficial access to foreign technology and long-range commitment in the early decisions during research and development. Both governments consistently supported the program despite international opposition. The author concludes that international non-proliferation measures have delayed the further spread to date (1988) but the motivational imperative will one day overcome the technological limitation in one or more of Israel's regional rivals.

The Brookings Institution provides a description of US non-proliferation policy within the general foreign policy context.[8] This compilation does not lean heavily in favor of any one of the technological, motivational, or idiosyncratic explanations, but addresses both intentions and capabilities. The contributing authors describe the context of the nonproliferation debate in nine states and in the Arab-Israeli conflict. The editor concludes with an equal emphasis on the importance of both (1) reversing each state's unique motivations and (2) blocking international technology transfers to limit state capabilities. This study is a more general review of the state foreign policy issues of nonproliferation.

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[7] Shyam Bhatia, Nuclear Rivals in the Middle East, London: Routledge, 1988; pp 108-112.

[8] Joseph A. Yager, editor, Nonproliferation and U.S. Foreign Policy, Washington D.C.: Brookings Institution, 1980, pp 407-425.

B. COMPARATIVE POLITICS MODELS

Donald MacKenzie presents an alternative political explanation for the development of increased missile guidance accuracy, which could be applied to explanations for the process of nuclear proliferation: successful technological change is dependent upon successful manipulation of existing economic constraints and political constraints.[9] MacKenzie refutes the supposition that states naturally seek advanced weapons technology with a case study of US development of nuclear missile guidance accuracy. Technological advancements must be considered within their organizational, political, and economic context.

Successful technology advances require the following conditions: first, developing an organizational base capable of pursuing the new technology, and second, persuading the political leadership of the feasibility of the practical applications. Mackenzie includes the roles of domestic frictions such as bureaucratic infighting and bureaucratic predisposition as well as state motivations to obtain the technology applications. Applying this potentially powerful argument to explain a case of potential nuclear proliferation requires unique access to a developing state's scientists and politicians. This model applied to Egypt's case of nuclear science development might show how Egypt did develop a scientific organization base but was not able to persuade the political leadership of the feasibility of military applications. The weak-state model compliments MacKenzie's political explanation of successful technological change.

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[9] Donald A. MacKenzie, Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance, Cambridge, MA: MIT Press, 1990, pp 382-423.

Peter Lavoy provides another political explanation for non-proliferation. He argues that an individual scientist or technical expert can sway the political decision either for or against proliferation by their unique technical and political qualifications.[10] This explanation is dependent upon the existence of such experts in the suspected state. The influence of the expert is limited by the decision-making pattern of the government, societal political culture, the relative strength of debate for and against proliferation at the policy-making level, and other case-unique factors.

James Katz and Onkar Marwah emphasize that nuclear proliferation is determined by scientific advancement with a political twist. Their review of developing countries nuclear programs presents the interaction of the scientific community with the political leadership. Scientists' influence is dependent upon the interaction of resource constraints, intellectual techniques and social (political) processes in each state.[11] Their case studies highlight the technological capability shortfalls in underdeveloped countries.

Scilla McClean analyzes nuclear weapons decision-making by the big five nuclear powers between 1982 and 1986. He concludes with similarities between the decision-making process of developing and expanding a nuclear weapons arsenal.[12] These political observations may be characteristic of a developing country's initial attempts at proliferation as well. They are: (1) political decisions made long before weapons applications are feasible were critical to future development, (2) state bureaucratic rivalry produced conflicting advice to the decision maker, (3) weak financial controls allowed political decision makers to hide relatively large unbudgeted expenditures, (4) secrecy obstructed potential contributions from scientists without access to the program, (5) secrecy excluded broader strategic policy options from consideration by key decision-makers, and (6) the atomic science bureaucracy competed with its superior government office, and evaded technical challenges from above. Given access to the founders of the Egyptian atomic science program, these observations could be proven to explain Egypt's not developing nuclear weapons.

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[10] Peter Lavoy, "Nuclear Myths and the Causes of Nuclear Proliferation," Security Studies, Volume 2 Numbers 3/4, Spring/Summer 1993, pp 192-212.

[11] James E. Katz, Onkar S. Marwah, editors, Nuclear Power in the Developing Countries, New York: Free Press, 1982.

[12] Scilla McClean, editor How Nuclear Weapons Decisions Are Made, New York: St Martin's Press, 1986, pp 254-258.

C. WEAK-STATE MODEL OF NUCLEAR NONPROLIFERATION

The tendency in the international relations literature is either to generalize the process of nuclear nonproliferation into models which lose explanatory strength when applied universally, or to treat each occurrence as idiosyncratic using a detailed case study. Each of the above authors provide partial explanations for individual cases of nuclear proliferation and nonproliferation. The political arguments of MacKenzie, Lavoy, and McClean are the point of departure for the weak state model of analyzing Egypt's nuclear nonproliferation.

The weak-state model for explaining why motivated and capable states do not acquire nuclear weapons is conditioned upon an adequate minimum industrial base and political-military motivations to do so. This model is not to be confused with the "domestic politics" element from the motivational hypothesis. In general terms, my argument posits that nonproliferation is a direct function of structural state regime weakness, not of particular domestic political agendas.

The state is the aggregation of institutions responsible for two broad functions: (1) extracting resources from society for the execution of policy, and (2) enforcing pronounced rules upon the society, using force if necessary. The state is characterized by a its capability to penetrate society, regulate social relationships, extract resources and appropriate the resources for specific purposes[13]. A strong state has consolidated power so that it may extract resources and enact policies. State strength is not measured by the degree of societal autonomy or by percentage of available resources extracted, but in the manner of compliance with state regulations and in how successfully the resources are employed to achieve specific objectives[14].

Historically, states gained the political strength to extract resources and enforce rules upon society within the context of violence, by war or violent revolution. Human violence, inflicted by armies or in the name of social justice, polarizes social groups into political constituencies. States which were formed absent this experience with war or violent political revolution usually demonstrate weak capability to extract resources and enforce rules upon their supposed constituency. As Barrington Moore has argued, immense political violence has always been the necessary condition for meaningful social change.[15] In the developing world, war or revolution created strong states whereas nontraumatic, peaceful "decolonization" resulted in weak states.

A strong state is typified by tangible results from application of extracted resources (people, capital, equipment), as well as day-to-day routine normative compliance with state regulations. In this case, application of extracted resources is the state's program to develop an advanced technology (nuclear science) for civilian and military applications.

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[13] Migdal, op. cit., p 4.

[14] Ibid., p 8.

[15] Barrington Moore Jr., Social Origins of Dictatorship and Democracy: Lord and Peasant in the Making of the Modern World, Boston: Beacon Press, 1966, pp 505-506.

A new technology with little chance of short-term return on investment requires initial research an development funding either by large corporations in the western industrialized states or by the government in the less developed modernizing states. Third-world states do not have the industrial capital in private hands for this type of advanced project. The state announces the nuclear development program, establishes organizations to administer it, allocates program budgets, appoints key administrators, and establishes criteria for recruiting personnel to work in the program. The degree of success of the program is limited by individual initiative, technical feasibility, and support from the state by application of extracted resources.

A strong society is one which has developed a civil code of rules autonomous from external influence. If these rules are not those adopted by the state, the strong society will not comply with state regulations. The strength of society is measured in terms of independence from social control by the regime. Revolutionaries can promise great reforms but they still need people to implement their policies - the more these reforms are different from established social patterns, the more coercive force is required to enforce them or else the state must yield to the preceding social hierarchy.

The tool of social control is the state bureaucracy, which includes the internal security forces and the army. In order for a new leader to maintain control of a strong society, the tools of social control must be made more powerful than rewards and sanctions imposed by preexisting power elites.

A strong state can encourage private and state-funded organizations as well as international scientific alliances to work independently from government controls, within state secrecy regulations. A strong state does not fear the mobilization of political opposition from the organizations which may develop a nuclear weapon.

A weak state, by the above definition, may manipulate administrative appointments to insure that the directors of such a program are loyal to the regime. If a weak state leader disrupts the nuclear development organization completely and disbands it, he runs the risk of the scientists and administrators forming an opposition party outside of the country and continuing their program with funding from rival states or rival political groups within the state concerned. It may be more effective for a weak state leader to coopt the potential leaders of such a nuclear development program into positions of apparent power, under the control of the state. Thus the potential nuclear weapons scientists may be given just enough of a state budget to keep them busy, or may be appointed to figurehead positions of dignity, with no potential to mobilize political opposition to the regime. A weak state cannot just fire a leader-scientist who appears disloyal - it must politically neutralize him from further involvement with that political interest group. Another tactic of a weak state may be to create organizations which will compete with each other for the same limited extracted resources - human capital (administrators, scientists, engineers, technicians) investment capital, and plant and equipment. Yet another tactic may be to create new administrative organizations to oversee the scientists' research and development. Banishment from the state is reserved for those individuals who will not be coopted to work in a less threatening capacity or those who cannot mobilize opposition to the regime from overseas (who have no expatriate constituency.)

Strong societies under weak states may show the following characteristics in a state strongly predisposed to nuclear proliferation. First, the scientific community may oppose the regime on political grounds. Alternately, the scientific community may form a coalition with other professional syndicates or politically mobilized groups, opposed to specific regime policies such as social justice for the lower classes, educational reform, or increasing military buildup. The extraction of natural resources, human capital, and investment capital can be delayed by the scientists' social networks. Thirdly, the scientific community may oppose the objective secretly, on moral or political grounds.

III. EGYPTIAN CASE STUDY: 1952-1981

Egypt's history of nuclear development is filled with contradictions which the weak state model explains better than any existing literature. Both Nasir and Sadat vacillated between empowering the atomic science program with consistent support and blatantly obstructing the program. In the process, Egyptian scientists developed the highest degree of technological experience possible, limited by changing levels of state support. The case study is ordered chronologically to contrast the regime's early commitment to going nuclear with its later interference in the project. In the long-run, from 1952 to 1981, domestic political security issues dominated international security issues. This is due to the nature of the state. Modern Egypt is a weak state attempting to govern a strong society.

A. INITIAL DEVELOPMENT OF LATENT NUCLEAR TECHNOLOGY CAPACITY

1. Egyptian Science Background

Egyptian industrialists created the initial demand for technological modernization even before the Free Officer revolution on 23 July 1952, according to Adel A. Sabet.[1] In 1939 the government established the Fouad I National Research Council to coordinate research for uses in agriculture, industry, public health, defense, and the national economy. The council remained inactive until 1947, when it drafted plans for a National Laboratory for Chemical and Industrial Research including a future national physics laboratory and an agricultural research station. The National Research Council merged with the Permanent Council for National Production in November 1953 to form the National Research Institute.[2] At the time of the 1952 revolution, Egyptian scientists possessed a small scientific cadre for industrial expansion. Whether or not the scientists were capable of administratively supervising a rapid industrial modernization program using advanced technologies is a separate question.

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[1] Adel A. Sabet represented the official Egyptian government position as a member of the General Department of Scientific Relations, Council of Scientific Research, at the Science and Technology in Developing Countries Conference held in Beirut from 27 November to 2 December 1967.

Shyam Bhatia supports Sabet's theme of a scientific community in search of government sponsorship. Of the 1400 Egyptian science graduates in 1952 (including undergraduate and graduate degrees), the majority specialized in medicine. At this time, some of these medical scientists sought radioactive isotope applications for use in hospitals. Additionally, Cairo University physicists wanted a Vandergraaf accelerator for particle physics basic research. Before 1955, the regime did not support these requests.[3] Cairo University began an undergraduate nuclear physics program in 1953.[4] This pool of scientists represents a significant potential for developing advanced technologies, provided they receive consistent financial and political support for basic research until industrial applications could be derived.

According to El-Sayed Selim, Egypt's early interest in nuclear technology was a response to external factors rather than internal economic or political demand. President Eisenhower's Atoms For Peace program was announced in December 1953. Under the terms of the Atomic Energy Act of 1954, the U.S. Atomic Energy Commission began negotiations in 1954 with Egyptian officials, resulting in installation of a radioisotope laboratory in the Egyptian National Research Center in June 1956 and training for Egyptian scientists.[5] This initial cooperation led to the training of 105 Egyptian scientists in the United States from 1955 to 1976.[6] Sometime in 1955 the U.S. offered nuclear technology for desalination and land reclamation through the Atoms for Peace program but Nasir refused it.[7] American assistance in Egypt's modernization was perceived at this time as a potential threat to Egyptian independence. The opposition to British colonialism had been the single theme of all political factions during the last twenty years of the Farouk regime, and Nasir's power was not yet consolidated to the point where he could invite another western government to invest in a large industrial venture.

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[2] Adel A. Sabet, "UAR Commitments to Science and Technology," from Claire Nader and A. B. Zahlan, eds., Science and Technology in Developing Countries, London: Cambridge University Press, 1969, pp 187-188.

[3] Bhatia, op. cit., p 49.

[4] Mohammed El-Sayed Selim, "Egypt," from James E. Katz, Onkar S. Marwah, eds., Nuclear Power in Developing Countries, New York: Free Press, 1982, p 137.

2. External Security Conditions

By 1955 both international political conditions and domestic scientific demands converged. The 1950 Tripartite Declaration by the US, Britain, and France had banned arms sales to Israel and the Arab combatant states. Nasir discovered evidence in January 1955 that the British and French were violating that supplier embargo. Turkey had signed a Western-sponsored security assistance agreement with Pakistan the previous April and another with Iraq in February 1955. Nasir's regime strongly opposed Western imperialism in the region in any form, economic, military, or political. The Free Officers employed the anti-imperialistic public consensus to mold a supporting coalition from 1952-

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[5] Ibid., p 135.

[6] Henry S. Rowan and Richard Brodie, "The Middle East," from Joseph A. Yager, ed., Nonproliferation and U.S. Foreign Policy, Washington D. C.: Brookings Institution, 1980, p 216.

[7] John K. Cooley, "Egypt Assessing Nuclear Strength," Christian Science Monitor, 2 January 1975, pp 1, 4.

1954, until they had eliminated all political rivals. Israel's announcement of a commercial nuclear cooperation agreement with France in 1954, may have increased Nasir's awareness of a potential nuclear technology race.[8] If not, Nasir's conversation with Indian leader Jawaharlal Nehru on 16 February 1955 must have impressed upon him the need to develop the new technology. Nehru said of atomic power: "It means strength in war and strength in peace, either through victory or through productivity."[9] According to Heikal, Nasir respected Nehru for his rational intellect. This recommendation could not have come at a more ironic moment in time, two weeks before the Israeli attack in Gaza.

The trigger event, if one exists, was an Israeli raid on the Egyptian army headquarters in Gaza on 28 February 1955. This disproportionately heavy attack in response to an intermittent stream of fedayeen small scale raids resulted in 38 Egyptians killed and 31 wounded.[10] Prior to this point Nasir had entered secret settlement negotiations with Israeli Foreign Minister, Moshe Sharrett. These international pressures caused Nasir to shift to a more confrontational foreign policy.

According to Anthony Nutting, Nasir made four decisions following the Israeli raid in Gaza: (1) to buy adequate conventional arms to deter further Israeli attack, (2) to strengthen Arab League security with a series of bilateral treaties, (3) to materially support the Palestinian fedayeen attacks on Israel, and (4) to launch a propaganda war against the pro-western Iraqi government and against

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[8] Bhatia, op. cit., p 38.

[9] Mohamed Hassanein Heikal, The Cairo Documents, Garden City, New York Doubleday and Company, 1973, pp 279-280.

[10] Robert H. Stephens, Nasser, A Political Biography, New York: Simon an Shuster, 1971, pp 145-158.

Israel.[11] In the context of this security decision, Nasir must have entertained suggestions to expand Egypt's nuclear infrastructure with a view to future military applications. Israel was already known to have begun its own civilian research program. As the most populous Arab state in the region, bordering on Israel, Nasir was pressured to compete with Israel's own science program in order to save Arab honor. In question is Nasir's own commitment to nuclear weapons. Professor Ibrahim Hilmy Abdel Rahman, a London-trained astronomical physicist who was Nasir's cabinet ministerial secretary after 1954 was strategically placed to advise Nasir to go nuclear.[12] At the time of these decisions, Rahman must have entered the consultative process as a technical expert, explaining the prospects for weapons applications of nuclear technology in a developing nation.

3. Early Scientific Drive

In March 1955 a committee of scientists and Free Officers met to discuss how to advance Egyptian nuclear research. As a result of this meeting, a Board of Atomic Energy was created to promote the peaceful uses of atomic energy and to train scientists in the related scientific fields of medicine and agriculture. The Atomic Energy Establishment, formed in October 1955, was divided into eight departments: mathematics and theoretical physics, experimental nuclear physics, nuclear chemistry, geology and raw materials, radio isotopes, radiation protection and civil defense, and engineering and scientific equipment and reactors.[13]

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[11] Anthony Nutting, Nasser, New York: E. P. Dutton, 1972; p 97.

[12] Clement Henry Moore, Images of Development: Egyptian Engineers in Search of Industry, Cambridge, Massachusetts: MIT Press, 1980, p 88.

[13] Bhatia, op. cit., 50.

Egyptian scientists attended the first conference on the Peaceful Uses of Atomic Energy in 1955, primarily as observers. The conference was chaired by Indian scientist Homi Bhabha, the architect of India's military and civil nuclear program. The Egyptian delegation included Professor Abdel Rahman, Dr. Ahmed Riad Turki (Cairo University Professor of Chemistry), Dr Mustafa Nazif (Dean of Engineering Department at Cairo University), and Professor El Halawani (Under-Secretary to Ministry of Family Planning). Two Egyptian graduate students from Curie Laboratory also attended: Ismail Hazza, studying cosmic ray physics, and Abdel Maaboud El Guibaily, studying nuclear chemistry. The delegation attended to gather information, not to report on Egyptian research. One scientific paper was presented on the subject of uranyl strychnine flouride, based upon a previous student's doctoral dissertation.[14] Such active participation in this conference signifies Egyptian interest in the state of nuclear scientific research conducted abroad at a time when the Egyptian universities were constrained by very limited laboratory research facilities. Perhaps a purpose of attending the conference was to establish professional contacts with leading scientists overseas.

Colonel Kamal el-Din Husayn, a member of the first Revolutionary Command Council, was appointed chairman of the Board of Atomic Energy and the Atomic Energy Establishment (AEE).[15] Professor Abdel Rahman was appointed secretary-general. Rahman's technical qualifications and his political connection to Nasir gave him wide latitude in the first five years of the Egyptian atomic energy program. Rahman was appointed director of the National Science Council in January 1956 was made responsible for national planning. Under his direction, the first long-range science plan was drafted in 1958. It emphasized basic research initially, with industrial applications to follow.[16] The AEE initially invested in basic research and overseas training. Rahman negotiated the first nuclear coordination agreement with the Soviet Union in 1957. Under the terms of the protocol, the Soviets agreed to train Egyptian nuclear scientists, supply a 2-megawatt research reactor, and provide a Vandergraf 2.5 megawatt particle accelerator for the AEE's theoretical physics laboratory.[17]

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[14] Bhatia, op. cit., pp 49-50.

[15] Richard H. Dekmejian, Patterns of Political Leadership, Albany, New York State University of New York Press, 1975, pp 176-179.

During the period 1956-1960, Nasir did not yet fully invest in this new technology. After the political success of the Suez nationalization and surviving military defeat in war, Nasir no longer felt the need to consult with his Free Officer peers, in making state policies.[18] He perceived that he did not need this weapon in order to defeat Israel. Moreover, this type of technology could not be obtained without foreign assistance and that assistance came with unacceptable political conditions. During this early period of his regime he was still obsessed with losing control of Egypt's newly-won independence to foreign creditors just as Khedive Ismail had lost control to the Europeans in the previous century.[19] Nasir's rejection of US arms in 1954, US nuclear desalination and land reclamation offers in 1955, and World Bank-Anglo-American financing for the Aswan High Dam in early 1956 may be partly explained by this fear of foreign economic control. This same concern for economic and political neutrality limited Egyptian nuclear development programs at a time when both the US and the Soviets were increasing access to "peaceful" uses of nuclear technology.

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[16] Moore, op. cit., p 88.

[17] Bhatia, op. cit., p 51.

[18] Raymond Hinnebusch, Egyptian Politics Under Sadat, Boulder, Colorado: Lynne Rienner Publishers Inc, 1988, p ???.

[19] Stephens, op. cit., pp 158, 170-173.

Meanwhile the efforts of the nuclear scientists proceeded apace. The Center for Nuclear Research was opened at Inchas in 1957.[20] In March 1957 the state newspaper Al-Ahram reported the formation of the Board of Atomic Energy into a new state corporation under Nasir's personal chairmanship.[21] Rahman continued on as AEE Director-General. Kamal al-Din Husayn was not relieved of his chairmanship of the Board of Atomic Energy. Nasir left Husayn nominally in that position. This reorganization reflects either: (1) that Nasir did not trust this Revolutionary Command Council Free Officer with this degree of power, or (2) that this program had become Nasir's personal pet project, or (3) that Nasir trusted Rahman to work independently of a political commissar, directing the technical aspect and to report back directly to the President. What is not clear is how far in the future Nasir expected military applications to become feasible.

Two of the six principles of the 1952 Revolution had been to eliminate foreign imperialism and to rebuild a powerful army. Nuclear weapons capacity would support Egyptian independence from western imperialism and complement the technologically inferior Egyptian military. Rahman was the technical point man for this decision, assuaging his fellow scientists that the Board of Atomic Energy symbolized Egyptian modernization.

Rahman negotiated the first nuclear cooperation agreement with the USSR in 1957. The protocol included Soviet supply of a small 2-megawatt research reactor at Inchas, a Vandergraaf 2.5 megawatt accelerator and training at undergraduate and graduate level in the USSR.[22] Rahman directed Nasir's long-range scientific and economic planning, and forecast dual civilian and military applications probably no earlier than the latter half of the 1960's. Initially, Nasir probably accepted the length of time before practical applications would be feasible. Indian Prime Minister Nehru's appeal to the US and the USSR in November 1957 for peaceful uses of atomic power was forwarded to Nasir with a personal note likely strengthening the peaceful uses plea.[23] Nasir may have supported this position then.

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[20] Shai Feldman, Israeli Nuclear Deterrence, New York: Columbia Universit
Press, 1982, p 71.

[21] El-Sayed Selim, op. cit., p 137.

Rahman's objective was to obtain foreign assistance for basic research, to develop civilian applications, and to train scientists, at a time when Nasir was attempting a non-aligned position balancing Western and Soviet assistance to Egypt. The leader of the atomic scientist community had a different set of priorities for modernizing, than the President. Egypt's principal trading partners from 1959 to August 1961 were, for export, the USSR and Czechoslovakia and for import, the United States, USSR and West Germany.[24] Beginning in 1955, the Soviet nuclear export policy was relatively unrestricted towards supposed allies. Moscow had technology export agreements with China and six eastern European states, including a 150-megawatt, heavy water-cooled reactor to Czechoslovakia. After Mao Tse-Tung attempted to use the Sino-Soviet alliance to wrestle the island of Quemoy from Taiwan in the summer of 1958, the Soviets began to implement a policy of nuclear export restraint, curtailing or re-negotiating previous agreements.[25] This Soviet nuclear export restraint may have slowed the delivery of the research reactor and Egypt's remaining requests for technical assistance through 1975. Western technology assistance held more potential than Soviet help until Nasir squandered his remaining international political capital in 1965.

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[22] Bhatia, op. cit., p 51.

[23] Heikal, 1973, op. cit., pp 288-289.

[24] "Egypt (UAR), Sudan and Libya, Annual Supplement" Economist Intelligence Unit (hereafter abbreviated EIU) London, April 1962, p 11.

In 1959 Egypt requested help from the German government for a national space program. This request was officially rejected but ten German scientists were secretly recruited into a liquid-fueled surface-to-surface rocket development program.[26] A separate project by the German firm Hoechst Farben Werke for a heavy water production plant was begun in 1959. Between 1956 and 1960 Egyptian surveys estimated recoverable reserves of 28,000 tons of uranium oxide and 370,000 tons of thorium oxide from heavy mineral sands and phosphate rock inside Egypt.[27] In December 1959 the official press reported discovery of uranium ore deposits near Rosietta and Demietta.[28] A Norwegian cooperation agreement was signed in December 1959 for construction of a radioisotope center. Professor El Guibaily, who had received his Nuclear Chemistry PhD from Curie Laboratory in Paris, received one year of postgraduate training in Norway's Nuclear Institute and returned to Egypt in 1959 to run the AEE department of chemistry.[29] In 1959 Dr.

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[25] Gloria Duffy, "Soviet Nuclear Exports," International Security, Volume 3, Number 1, Summer 1978, pp 85-86; see also, Benjamin S. Lambeth, "Nuclear Proliferation and Soviet Arms Control Policy," ORBIS, Volume XIV, Number 2, Summer 1970, pp 308-311.

[26] Lewis A. Frank, "Nasser's Missile Program," ORBIS Quarterly Journal of World Affairs, Volume XI, Number 3, Fall 1967, p 749.

[27] Taysir N. Nashif, Nuclear Warfare in the Middle East: Dimensions and Responsibilities, Princeton, New Jersey: Kingston Press, 1984, pp 28-30.

[28] El-Sayed Selim, op. cit., p 137.

[29] Bhatia, op. cit., p 52.

Eizzat Abdel Aziz, an Egyptian physicist working as the Argonne research center in the United States, noticed two Israeli scientists at the same institution studying plutonium reprocessing. He reported the weapons implications of this research to his home office.[30] This report should have immediately spurred Nasir to raise the priority of the Egyptian nuclear program, if it was passed along to Nasir. It occurred at a time however when Nasir had just fired his AEE director for political insubordination, and so the AEE probably did not receive the budget priority to oppose the Israeli threat.

Clement Moore believes domestic politics interrupted the development of the Egyptian nuclear technology infrastructure in 1959, by firing Rahman. Rahman opposed Nasir's over-ambitious development plan to double gross national product in ten years. As the National Science Council director, Rahman had defined the goals of the scientific research plan as: (1) support for basic or academic research, (2) selection of research topics based upon individual scientists' initiative, (3) equipment support and foreign study assistance, and (4) applied research.[31] An aggressive, ten-year development plan would require a basic sciences infrastructure much broader than Egypt possessed to date. The Science Council's initial budget request was cut in half. The 1960-1965 five-year science plan requested 19,673,250 pounds, and the government allotted 8,439,893 pounds.[32] According to Moore, Rahman was relieved of his AEE and Ministerial positions in 1959 and reassigned to a position in the Ministry of Planning where he could no longer influence science policy.[33] Bhatia explains the non sequitur of Rahman's reassignment as due to some inexplicable personal desire. Moore's explanation is more consistent with Nasir's previous history of silencing uncooperative Free Officers. Rahman, with a foreign degree, was respected within the Egyptian scientific community, and the Egyptian atomic development program had only recently begun to bear fruit in the form of foreign assistance. He would not have left such a position voluntarily, at that time, unless he had lost Nasir's personal confidence and was no longer scientifically independent. Whether any succeeding AEE directors could have continued the emphasis on basic science development and training or would have given in to political pressure for more immediate science applications is unclear. The successor who emerged did support military applications though.

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[30] Ibid., p 54.

[31] Sabet, op. cit., pp 191-192.

[32] Ibid., p 193, based upon Sabet's access to Egyptian government documents. No other sources were found to verify these figures.

Prior to Rahman's firing, one observes evidence to support both the motivational imperatives and the weak state model. The motivational imperative evidence includes Nasir's regional power pretensions, Egypt's quest for military superiority versus Israel, Egypt's low defense establishment morale after the 1956 war, and future economic spinoffs. Possible dissuasive restraints include the strategic credibility gap of Egypt's acquiring nuclear weapons before possessing state-of-the-art, advanced weapons for conventional forces, and the absence of a perceived nuclear threat from any state in the region. The weak state hypothesis is supported by Nasir's initial appointment of a Free Officer within the original core of the Revolutionary Command Council as senior administrator, supposedly a man politically loyal to Nasir, without technical qualifications, to supervise scientific development. Only in a weak state would a leader appoint a loyal military man to supervise a highly technical program. In 1957 Nasir was announced as the chief of this state corporation, removing all doubt as to who was in command of the AEE.

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[33] Moore, op. cit., p 89.

B. APPLIED SCIENCE EMPHASIS

1. Politicization of the Atomic Energy Establishment

The scientific direction of the AEE lapsed from 1959 to 1961. The Chairman of the Board of Atomic Energy, Kamal al-Din Husayn, wanted to appoint a Free Officer with a bachelor's degree in chemistry who had allegedly made nitroglycerin grenades before the revolution, Colonel Salah Hedayat. Apparently the other members of the board suspected Hedayat was not technically qualified to be director-general. A civilian professor was appointed at first, but when it became clear that he would not receive the political backing of the regime, the other Board members relented to Hedayat's appointment in the fall of 1961.[34] Hedayat served for four years as the executive of both the independent Atomic Energy Establishment and the five year science plan. In retrospect, this period was the most critical to the frustration of the Egyptian nuclear weapon effort, because a science community leader who was not as politically threatening as Hedayat turned out to be, might have succeeded in making Egypt an atomic power.

In June 1960 Israel's 1-megawatt research reactor at Nahal Soreq began operating. In December West Germany signed an agreement to assist Egypt with atomic energy development for peaceful purposes[35]. Up to this point, Egyptian intentions are problematic. Nasir appears to have been sincerely interested in developing the technology for dual civilian and military uses in the future, ten years or more distant. The Egyptian science plan drafted by Rahman probably did not satisfy Nasir's goals of near-term-future and present-use applications of new technology. Nasir may have confused the initial progress demonstrated by acquisition of a research reactor, advanced laboratory equipment, and cooperation agreements with Germany, Norway, the United States and the USSR, as signs that the Egyptian nuclear development program was nearing the adolescent point when it could stand without foreign assistance. The events of December 1960 dramatically increased the importance of Egyptian nuclear technology acquisition beyond a far-distant future capability.

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[34] Moore, op. cit., pp 88-89.

[35] "Atomic Energy Aid for U. A. R.", London Times, 5 December 1960, p 10g.

The New York Times reports of the Israeli power reactor under construction at Dimona from 19-22 December 1960 sparked a flurry of Arabic press reports with mixed views on the likelihood of Israel's going nuclear.[36] This returned Nasir's attention to the nuclear technology race with Israel. Possibly this news triggered a decision to expedite the weapons development efforts of the Egyptian AEE. The Dimona revelation occurred against a background of a secret nascent German-Egyptian rocket program, and Nasir's undisputed leadership of the Arab nationalist movement.

The public posture which Nasir presented may be better understood within the Egyptian cultural context. This new reactor posed a threat to Egypt which had to be answered in some manner - if only symbolically. Arab collective honor could not be shamed by the appearance of technological inferiority. Nasir's public speech reflected both hope that Israel would not develop atomic weapons, and his responsibility to protect the Arab states from such an occurrence. If Israel was developing an atom bomb, it would mean

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[36] Yair Evron, "The Arab Position in the Nuclear Field: A Study of Policies up to 1967," Cooperation and Conflict, number 1, 1973, pp 21, 30.

> the beginning of a war between us and Israel, because we cannot permit Israel to manufacture an atomic bomb. It is inevitable that we would attack the base of aggression, even if we have to mobilize four million men to destroy it[37].

The United States also perceived this development as a risk to the stability of the region. President Eisenhower demanded an explanation from the Israeli Prime Minister during the last three weeks of his Presidency.

The Israeli development led to the first inter-Arab discussion on a potential nuclear threat in February 1961, in Baghdad. The Foreign Ministers approved an Arab plan which included overt measures to urge the IAEA to investigate the Israeli power reactor under construction, as well as unmentioned covert measures. After the meeting, Israel and the Atomic Bomb was published in Arabic by Mustafa Hasan. This book was published in Beirut, relatively free from government censorship. It included speculation of the French assistance in bomb development and suggested Arab duties to respond to the Israeli program. Two months later the Arab Military Consultative Committee, composed of the military chiefs of staff, met to study the Palestinian issue and the Israeli-French bomb development program. Both the London press and the Egyptian press reports on this meeting only mentioned the Israeli nuclear development perfunctorily.[38] This may indicate Nasir's difficulty in forging a unified Arab consensus on the issue, only further pushing Nasir to develop his own capability independently.

This public leak coincided with the change of leadership after Rahman's departure in 1959, away from emphasis on basic sciences and overseas training toward military and industrial applications of scientific research.[39] Sometime during 1961 Nasir decided to increase budget support for those activities which would lead directly to a nuclear weapons capability: the German-Egyptian rocket program and the AEE. A chemical warhead rocket and a cobalt-60 warhead were short-range, intermediary components of this overall effort at strategic parity with Israel. This decision may have come immediately after the December 1960 report or later after the July 1961 public launching of an Israeli research rocket.[40]

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[37] Feldman, op. cit., p 256.

[38] Evron, op. cit., p 21.

In January and February 1961 German and other foreign national scientists began consultations with the Egyptians on a plan for an atomic reactor.[41] In April 1961 a cooperation agreement was signed with Yugoslavia for extraction of previously discovered uranium and thorium ore within Egypt. This program matured into an Egyptian ability to locally produce a measuring device for analyzing radioactive materials.[42] The Soviet supplied research reactor began operation in July 1961, two years behind schedule.[43] The ten percent enriched uranium fuel was supplied by the Soviets. This research reactor was made safe by the physical presence of Soviet technicians and was not put under IAEA authority for safeguarding until Egypt ratified the NPT in 1981, however the Egyptians allowed a one-time IAEA inspections in August 1960, while it was under construction.[44] The Soviets used their own bilateral safeguard system to prevent diversion of fuels for making weapons. This construction delay could be explained by the changed Soviet nuclear export policy after 1958, mentioned above. According to Bhatia, the Egyptian scientists wanted to upgrade the research reactor to a larger capacity, but the Soviet specialists advised against that until after experience was gained from the first reactor. In the summer of 1961, Salah Hedayat was first appointed Chairman of the Atomic Energy Board and Director-General of the AEE, and after the Syrian secession from the United Arab Republic in September, Hedayat was given a cabinet level position in the reorganized Nasir government, Minister of Scientific Research.[45]

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[39] Bhatia, op. cit., p 89.

[40] Frank, op. cit., p 750.

[41] Nashif, op. cit., p 27.

[42] El-Sayed Selim, op. cit., p 137.

[43] Bhatia, op. cit., p 52.

[44] Directory of Nuclear Reactors, Volume III, Vienna: International Atomic energy Agency, 1960, p 143; Nashif, op. cit , p 27.

That the Egyptian atomic development program suffered during this period from the friction of bureaucratic politics, is a reflection of Egyptian cultural tendency to create large bureaucracies.[46] Replacing the previous National Science Council, the Ministry of Scientific Research gave the director cabinet-level authority which the Science Council had not had beforehand. The Scientific Ministry's exact organization and functions were officially defined in January 1963. The AEE remained independent from all other scientific organizations, directly responsible to the Prime Minister, from 1955 to 1963 and from 1964 to 1967. During 1963-1964 the AEE was attached to the Ministry of Scientific Research, the final part of Hedayat's organizational empire-building. The 1961 reorganization which brought in Hedayat as Science Minister, Chairman of the Board of Atomic Energy and Director-General of the AEE, was an integral part of the 1961 socialist reforms. Between 1961 and 1963, Hedayat reorganized the science ministry into eight functional departments, a department to manage foreign scientific relations, and an Academy of Sciences. National science policy emphasis shifted from basic scientific training and infrastructure to applied research. According to Moore, the 1960-1965 Science Council plan began to fall short of its goals by 1963. This may be partly explained by the science organizational turbulence of this period or the overall domestic economic downturn which occurred from 1960 to 1965. When Hedayat was fired, the ensuing reorganization dissolved the ten departments and created a Supreme Council of Scientific Research, with the AEE reverting to autonomous status directly under the Prime Minister.[47] According to El-Sayed Selim, Hedayat was subordinated in May 1964 to Deputy Premier Kamal El-din Rifaat, (one of the revolution era second-tier Free Officers[48], a radical socialist, who had ascended politically to become one of the Tripartite Commission of the ASU in 1963[49]). Later, when Rifaat lost Nasir's confidence Marshal Amer was given supervision of the Board and the AEE.[50] Amer probably controlled the AEE until after the June 1967 War when he was politically discredited by military failure.

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[45] Bhatia, op. cit., p 53.

[46] Nazih N. M. Ayubi, Bureaucracy and Politics in Contemporary Egypt, London: Ithaca Press, 1980, pp 497-514.

Alexandria University established a department of nuclear engineering in 1962.[51] An agreement to develop atomic energy for "peaceful purposes" with India in 1962 expanded the overseas scientist training program to include India.[52] In August, according to an Israeli news report, foreign assistance to Egypt included atomic scientists from

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[47] Sabet, op. cit., pp 189-195 and Moore, op. cit., p 89.

[48] Dekmejian, op. cit., p 178.

[49] John Waterbury, The Egypt of Nasser and Sadat, Princeton: Princeton University Press, 1975, p 319.

[50] El-Sayed Selim, 1982, op. cit., p 145.

[51] Bhatia, op. cit., p 54.

[52] Evron, 1973, op. cit., p 20.

Britain (12), Czechoslovakia, (13), and Japan (21).[53] This may be purely Israeli propaganda, but it would not be inconsistent with open international nuclear export policy of that period. Previously, in June, the Nasir regime declared the superiority of applied science over basic science in the new revolutionary ideology of the National Charter.

> Science is the true weapon of the revolutionary will. . . . The major economic and social problems confronting our people at present must be solved on a scientific basis. The scientific research centres are required at this stage of struggle to develop themselves so that science would be in the service of society. **At this stage, science for its sake is a responsibility with our national potentiality cannot shoulder.**[54]

2. Government Budget Support

A key to explaining Egypt's atomic development program is understanding the division between rhetorical support for advanced sciences and actual allocation of government resources. This government budget information is both highly guarded as a national secret and difficult to divine in practical terms. The government changed its budgetary fiscal year in 1975 from beginning 1 April to a western calendar year basis, and again in 1981, from a calendar year basis returning to a fiscal year beginning 1 July. One opinion is that these changes were made in order to hide irregularities from potential creditors or to keep secrets for those years in which the changes were made.[55] Sabet admits the difficulty in measuring amounts of the government budget devoted to research within each department and ministry. Sabet's research shows that between 1959 and 1965, scientific research expenditures had risen both absolutely and as a percentage of national income. For comparative purposes, three sets of budget data are given. Table 1 signifies the effect of the Science Council's five-year plan on the allocation of scientific research in the command directed economy of 1961-1965.

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[53] Nashif, op. cit., p 27.

[54] Sabet, op. cit., pp 219-220, (my emphasis).

[55] Conversation with Professor Bent Hansen, retired Berkeley professor of economics.

TABLE 1. RESEARCH EXPENDITURES IN RELATION TO NATIONAL INCOME (in millions of Egyptian pounds)[56]

	Fiscal Year			
	1959/1961	1962/1963	1963/1964	1964/1965
Total Science Research	2.3	7.5	7.9	8.0
National Income	1,285.2	1,562.8	1,739.6	1,884.0
Percentage Research/Income	0.18	0.48	0.45	0.43

A second standard for measuring the relative accuracy of science budget data is included as Table 2. The Egyptian science budgets were probably in the range of six to ten million Egyptian pounds during this period, which included the Atomic Energy Establishment budget. The science ministry budget excludes graduate-level research performed at the Universities in Cairo, Alexandria, Ain Shams and Assuit.

TABLE 2. SCIENCE RESEARCH BUDGETS (in millions of Egyptian Pounds)[57]

	Fiscal Year			
	1959/1961	1962/1963	1963/1964	1964/1965
Atomic Energy	-	2.397	2.042	2.255
Ministry of Science Research	-	3.843	4.328	4.187
(National Research Centre)		1.238	*	*
Subtotal		6.240	6.370	6.442
Ministry of Education	-	61.292	64.650	67.070

* NRC budget allocated to Ministry of Science from 1963-1964

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[56] Sabet, op. cit., p 199.

[57] Sabet, op. cit., p 198.

Contrary to the above data, the Economist Intelligence Unit reports show that the 1963/1964 investment budget actually cut scientific research by 17 percent to 3.8 million Egyptian pounds from 4.6 million the previous year while increasing overall state investment expenditures by 13 percent from 362.0 million Egyptian pounds to 410.1 million in 1963/1964.[58]. The following table is presented in order to gain a sense of the magnitude of the scientific investment budget compared to other government investment programs during this period. If the statistics are purely intelligence deception, the relative weights of each sector are meaningless. Note the closeness in order of magnitude of the EIU 1962/1963 science expenditures with the Sabet data from that period. According to Nasir's National Charter, basic science would not receive a significant portion of the budget compared with applied science projects such as the High Dam.

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[58] "Egypt (UAR), Sudan, and Libya," Annual Supplement, March 1964, EIU, p 11. Egyptian Finance Ministry sources are always of questionable accuracy. Notably, disaggregated investment statistics are not available in succeeding EIU reports.

TABLE 3. EGYPTIAN INVESTMENT EXPENDITURES (in millions of Egyptian pounds)

Sector	Fiscal Years		
	1961/62	1962/63	1963/64
Agriculture	40.3	40.8	54.7
Irrigation	19.4	18.2	13.7
Electricity	15.3	16.2	22.0
High Dam	12.6	34.6	55.4
Industry	93.3	115.4	140.5
Transport & Communications	56.5	33.4	24.0
Suez Canal	18.0	9.3	8.0
Housing	13.2	46.0	36.1
Defense, Public Security & Justice	-	2.0	2.9
Education	-	12.4	9.8
Health	-	6.7	6.7
Ministry of Culture	-	6.3	9.5
Social and Religious Services	-	2.1	2.0
Scientific Research	**-**	**4.6**	**3.8**
Storage and Maintenance	-	8.0	16.1
Administration	-	-	0.4
Commercial and Financial Services	-	6.0	4.4
Total	320.0	362.0	410.1

Antoine Zahlan has argued that the Nasir regime did not commit an adequate portion of the development budget to science research, or basic science for either civilian or military technological independence[59]. The above budget statistics point out the bureaucratic competition which the Science Ministry faced in justifying government budget needs. The decline in science research from 1962/63 to 1963/64 reflects the fact that during that period the AEE budget was separate from the Science Ministry. What cannot be explained is why the AEE could not have received a substantially higher percentage of the investment budget given its special autonomy from the Science Ministry. The partial explanation may be that Nasir did not want to risk too much on a future technology which required a high initial investment with years-long return on investment. Absent a politically-supported scientist like Rahman, who succeeded in wringing out greater resources from the government, the AEE was financially supported by less than one tenth of a percent of the national income in the 1964/65 budget.

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[59] Antoine B. Zahlan, "The Science and Technology Gap in the Arab-Israeli Conflict," Journal of Palestine Studies, Volume 1, Number 3, Spring 1972, pp 17-36; see also, A. B. Zahlan, Science and Science Policy in the Arab World, London: Croom Helm, 1980.

3. Steady Progress With Foreign Assistance

The Cairo Radio Isotope Center was renamed the Regional Isotope Center in 1963 and complied with International Atomic Energy Agency inspections and safeguards.[60] This is due to the influence of the United States in establishing the center. Meanwhile the search for a foreign power reactor continued. In January 1963, a British firm had begun preliminary discussion with Egyptian representatives for a 250-megawatt nuclear power station.[61] In May 1963 Al-Ahram announced that Minister of Science Hedayat signed an agreement with a British consulting group to analyze economic feasibility and potential sites for a nuclear power plant.[62] In September, the Israeli press reported that an Egyptian mission attempted to purchase a 200 megawatt capacity, heavy water-cooled power reactor from France.[63] This allegation is difficult to explain since France had continued assistance to Israel through the 1960 Sahara weapons test.

Internationally, both Egypt and Israel supported the nascent international convention banning certain kinds of tests of nuclear weapons. Both Israel and Egypt signed the 1963 Partial Test Ban Treaty in August 1963. Egypt ratified it five months later 10 January 1964 and Israel five days later, on 15 January 1964.[64] Neither state sacrificed large measures of control by participation in this treaty.

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[60] John K. Cooley, "Cairo Steers Clear of A-race," Christian Science Monitor, 9 June 1969, p 4.

[61] "Egypt (UAR), Sudan and Libya," EIU number 40, January 1963, pp 3-4.

[62] El-Sayed Selim, op. cit., p 138.

[63] Evron, op. cit., p 20.

The AEE conducted its own survey in 1963 for future nuclear power plant sites. The results of the survey were included in a paper presented at the 1964 Third International Conference on the Peaceful Uses of Atomic Energy by the Egyptian delegation.[65] The justifications given for the nuclear power plant were both to fulfill electricity demand, to introduce nuclear power technology to Egyptian scientists. The Egyptian plan called for at least one 200-megawatt power plant operational by 1972 at one of five surveyed sites.[66] By that time a West German firm, Siemens, was conducting advanced negotiations for a natural-uranium fuelled, heavy-water cooled reactor at Burg El Arab. These plans were cancelled with the German diplomatic rupture the next year. Sometime in 1964, the Soviets were asked to help establish radio chemistry "hot labs" at Inchas, which would give Egyptians experience at nuclear waste handling and waste reprocessing.[67] These plans were suspended in 1965. Egypt bought 2 kilograms of natural uranium from Britain in November 1964.[68] This is the first purchase of fissionable material registered with the IAEA. The initial start-up fuel for the research reactor remained the responsibility of Soviet technicians.

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[64] United States Arms Control and Disarmament Agency, Arms Control and Disarmament Agreements, 1982 Edition, Washington D. C.: ACDA, 1982, pp 44-45.

[65] Bhatia, op. cit., p 55.

[66] Ibid., p 55.

[67] Ibid., pp 54-55.

[68] Congressional Research Service, Environment and Natural Resources Division. Nuclear Proliferation Factbook, Washington: US Government Printing Office, 1980, p 298.

According to Evron, the Israeli nuclear potential was not at the top of the Arab summit agendas in 1964 and 1965. More likely it was discussed in high level meetings but kept out of the press. The one public mention was a resolution after the 1964 summit for establishment of an inter-Arab body for "Atoms for Peace".[69] This was the second call for a joint Arab nuclear development effort, which was never realized in succeeding attempts through to the present.

Also in 1964 the Qatarra Depression nuclear power and desalination project was being considered. This project was opened for bids as a first of a series of plants along the Mediterranean and Red Seas coasts. The power plant was to have a capacity of 150 megawatts and be capable of producing 53 million gallons of water a day, used to irrigate a 10,000 acre farm. The government reportedly had allocated 28 million Egyptian pounds for the project but expected a large measure of financing credit. The AEE had even considered use of atomic explosives to dig an 80-mile canal from the sea to the point of the nuclear-agricultural industrial complex.[70]

By January 1965 Egyptian scientists had developed techniques to extract 6 percent thorium oxide and 45 percent uranium oxide from monazite deposits in the Mediterranean coastal area between Demietta and Port Said.[71] This foretold a future Egyptian capability to produce power reactor fuel without foreign help. After the break with West Germany, negotiations were conducted with three American firms: Westinghouse, General Electric, and Combustion Engineering. The bids ranged from $50 to $70 million, but Egypt could not obtain the sizeable credits need to finance the project.[72] The Qatarra Depression project was declared to be a feasible means of producing electricity and was programmed to begin in 1968 at a cost of 120 million Egyptian pounds.[73]

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[69] Evron, op. cit., pp 21-22.

[70] "Egypt (UAR), Sudan and Libya," EIU, number 47, October 1964, p 2.

[71] El-Sayed Selim, op. cit., p 155

4. The Egyptian Rocket Program

In the early 1960s, the Israelis considered a cobalt warhead mounted on the advanced V-2 rocket design to be a plausible threat, and conducted covert and diplomatic operations to remove the German scientists from the project. Between 1961 and 1962 as many as 250 German scientists and engineers were in Egypt working on the Egyptian long-range rocket program. Sometime in 1961 the Israelis learned of the Egyptian-German effort. Reportedly the Germans were being paid well for their services, indicating Nasir's intention to develop a credible threat. Alone, the estimated $450,000 per year paid to the top four scientists in 1962, made up one tenth of the 1962 science plan budget (E 1,926,579 pounds).[74]

Former Prime Minister David Ben-Gurion explained that the Israeli rocket launch in July 1961 was performed in order to pressure the Egyptians to openly announce their own program. The Egyptians publicly revealed two new types of missiles in the July 24, 1962 Revolution Day parade. One was reported to have a range of 235 miles and a 1,000 pound conventional explosive warhead and the other a range of 375 miles and a 1,500 pound warhead.[75]

Israeli covert attacks to halt the Egyptian-German rocket program from 1962 to 1963 were partly successful. Two examples of

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[72] Bhatia, op. cit., p 55; El-Sayed Selim, op. cit., p 138.

[73] "Egypt," EIU, number 50, p 7.

[74] Frank, op. cit., pp 752-753.

[75] Frank, op. cit., pp 752-753.

Israeli covert operations are the November 1962 parcel bomb which exploded in the Cairo office of the chief German scientist, Professor Wolfgang Pilz, blinding his secretary, and the attempted abduction of a daughter of a German scientist working in Egypt in March 1963. The Israeli agents were arrested in the second incident and during the ensuing public trial, defended themselves with evidence that Egypt was developing missiles fitted with cobalt-60 warheads.[76]

Israeli and western diplomatic pressure from 1963 to 1965 was eventually successful in pressuring the German government to withdraw their scientists from Egypt in March 1965. In 1963 Israeli Foreign Minister Golda Meir publicly declared that Egypt was developing radiological (cobalt), biological and chemical weapons of mass destruction for use on the rocket under development. By March 1965, a proposed West German sale of 200 tanks to Israel, and Nasir's reception of the East German leader Walter Ulbricht in Cairo, directly led to West Germany recalling all German citizens from Egypt, and a subsequent break in diplomatic relations between the two governments.[77]

The United States was also concerned with the growing perception of an Egyptian-Israeli arms race at this time. President Johnson dispatched Under-Secretary of State Talbot to Cairo in April 1965, with a message that if Egypt did not accept US inspection of nuclear activities and the rocket program, and limit Egyptian conventional military forces, the United States would supply Israel with any arms requested. The larger context of this message was the three-year-old Egyptian-American trade of $431.8 million in wheat, oils, tobacco and poultry. Nasir had requested emergency financing of $35 million in

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[76] Howard M. Sachar, Egypt and Israel, New York: Marek Publishers, 1981, pp 131-132.

[77] Frank, op. cit., pp 753-754.

September 1964, which was refused. Nasir rejected the American conditions for continuing agricultural imports and stated that Egypt refused to freeze the armed forces strength, cease production of rockets or refrain from seeking nuclear weapons. He implied that he would get the necessary help from the Soviets.[78]

By early 1965, more evidence appears to support the weak state model for nuclear proliferation. The necessary condition of motivation is established. By 1965 the proliferation motivations which may have influenced Nasir were Israel's potential for developing nuclear weapons, and Nasir's pan-Arab appeal for regional power status. Among the dissuasive factors are the strategic credibility gap favoring conventional weapons (which is why Nasir attempted to develop Egyptian rockets able to hit Israeli cities), threat of Israeli preemptive intervention, and Egyptian foreign technological dependence coupled with vulnerability to foreign trade embargoes. The technological constraint argument is not applicable yet because foreign technical assistance was relatively unconstrained.

The evidence which supports the weak state hypothesis is the two-year vacancy of the AEE Director-Generalship after firing Rahman, appointment of a loyalist Free Officer as the combined director of the Board of Atomic energy, the AEE, and the Ministry of Scientific Research, Hedayat's firing at the peak of his bureaucratic empire-building, the temporary subordination of the AEE (without an approved Director-General) under Deputy Premier Rifaat (also a Free Officer), and the abolition of the Ministry of Scientific Research. This is notable in the period when Nasir appeared to be strongly supportive of an Egyptian nuclear weapons capability, allowing Hedayat to grow more bureaucratically powerful for three years.

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[78] "Egypt," EIU, number 50, July 1965, p 3; Stephens, op. cit., p 457.

5. Request For Weapons Technology

The Egyptian nuclear development program faced a decision point in the summer and fall of 1965. The AEE director and Science Minister had been sacked, and reappointed Nasir's personal science advisor. Diplomatic rupture with Germany terminated a promising Western military technical assistance program. Perhaps the need for foreign financing credit and the realization of technological dependance lessened Nasir's expectations that this advanced technology could be developed during the short-term future of the next five-year plan. The Egyptian rockets were no longer displayed after the 1965 Revolution Day parade.[79] Nasir preferred to keep secret their degree of development before the Germans pulled out.

The editor of Al-Ahram, Cairo's daily newspaper, Mohamed Heikal, wrote a full page editorial on 15 October 1965 discussing the Egyptian position regarding Israel's atomic potential. Heikal first broached this subject in the previous two months, but he developed it further at this time. Nasir must have wanted to emphasize the issue with the Arabic readership for some reason. He had prevented all mention of it in the official press since his January 1961 interview. Heikal's access to Nasir is unquestioned. He co-authored Nasir's political biography The Philosophy of the Revolution in 1954. The editorial sounded the alarm that the "Israeli atomic potential" would be realized within three years and this danger required Egypt to respond with preventive action because it was the only state able to face Israel scientifically, economically, and militarily. It suggested Egypt must take the initiative and either move for protection or conduct a limited strike against the Dimona reactor. Heikal suggested Israel's own response if Egypt acquired atomic weapons first, as either an Israeli air or missile strike on the Egyptian atomic center (Inchas) or a total preventive war begun by an air or missile strike, (implied to be on Inchas). Heikal stated that the second five-year plan would establish heavy industry and electric power for every home and industry.

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[79] Frank, op. cit., p 747.

"Protection" could be interpreted as a Soviet nuclear deterrent or an Egyptian deterrent of its own. The article implied that Egypt did not yet possess an equivalent strategic deterrent - that Egyptian rockets were not a threat to Israeli population centers. Five days after Heikal's article, Ahmed Khalifa wrote a lengthy article in Beirut's Al-Huria echoing the call for a preventive war against Israel in order to destroy the atomic power reactor at Dimona.[80]

Heikal's public airing of the issue provided the regime the following domestic political benefits. It reassured the Egyptian people that the government would do something to solve the problem. It called for a unified Arab effort unsuccessful so far, militarily and economically. It could be interpreted as a request for Arab investment funds to support Egypt's nuclear program. It appealed to the other Arab states to support Egypt's warnings of Israeli atomic potential at the Casablanca summit just passed. Perhaps it was an appeal for Egypt's own businessmen to help finance the program. Such a pronouncement may also have been intended to soften Soviet resistance to technical assistance requested.

The public pronouncement in October, taken together with the direct approach to the Soviets two months later to buy nuclear weapons (or the weapons technology), is the watershed event proving the weak state model.[81] It shows the dynamic effect of domestic security priorities and international security priorities on leadership decisions. Nasir had fired the AEE director who had strongly pursued the military applications of this technology, for domestic political security. Less than two years later, Nasir wanted nuclear weapons for international security reasons. Moscow refused to provide Cairo with nuclear weapons or weapons technology, but promised a "guarantee of protection if Israel developed or obtained such weapons". Evron suggests that although the Egyptian officially denied these reports, the public knowledge of a possible Soviet guarantee did not damage Egypt's official position as a neutral power and allowed by Moscow and Cairo diplomatic maneuver space to involve the US and prevent Israel from using nuclear weapons in war.[82]

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[80] Evron, op. cit., p 22.

[81] Hedrick Smith, "Soviet Said to Offer Cairo Atom Defense," New York Times, 4 February 1966, pp 1, 12.

6. Conflicting Signals

After the failed approach to the USSR in 1965, the Egyptian nuclear development program was apparently relegated to secondary importance. Table 4 shows that the first two years of the second five-year plan reflect a decrease in both AEE and total science budgets below the first five-year plan. Nasir wanted to limit both the AEE and Science Ministry after 1964, to preclude Hedayat's successor from consolidating bureaucratic power. Note the increase in the National Research Center (NRC) budget in 1966/1967.

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[82] Evron, op. cit., pp 28-29.

TABLE 4. RESEARCH BUDGETS (in millions of Egyptian Pounds)[83]

	Fiscal Year			
	1962/1963	1964/1965	1965/1966	1966/1967
Atomic Energy	2.397	2.255	1.145	1.147
Ministry of Science Research	3.843	4.187	2.776	3.023
(NRC)	(1.238)	*	(1.166)	(1.425)
Subtotal	6.240	6.442	3.921	4.169

* NRC budget allocated to Ministry of Science from 1963-1964

In October 1965 the Supreme Council of Scientific Research was established to improve science coordination between the executive policy making and the research institutes.[84] This council may be what Heikal referred to as a new ministry. The above reference to a Ministry of Science Research appears to contradict the report that the Science Ministry was abolished in 1965.[85] According to Sabet, a new council for the Promotion of Scientific Research continued the functions of the dissolved Science Ministry from 1964 until the Supreme Council of Scientific Research was formed in 1965. The Science Ministry was officially revived under the cabinet reorganization accompanying the 30 March 1968 Statement. The council president held ministerial rank and was directly responsible to the Prime Minister. The Director of the AEE was a member of the Supreme Council for Scientific Research and also directly responsible to the Prime Minister. Dr Hussein Sait, a former Free Officer, and a respected academic who had run the NRC in the mid 1950s, was appointed Chairman of the Board of Atomic Energy. El Guibaily was appointed Director-General of the AEE. Both apparently had respected scientific credentials. Sait attempted to change Hedayat's emphasis on applied research, but the resulting staff was overburdened with daily operations of the research-institutional empire Hedayat had built, and the state budget cuts prevented basic science development.[86]

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[83] Sabet, op. cit., p 198.

[84] Ibid., p 189.

[85] Moore, op. cit., p 90.

In 1966 the Israeli atomic threat made repeated headlines in international press. The Soviet nuclear guarantee was unofficially admitted in February to the New York Times reporter covering the story.[87] By this time Nasir believed Israel had the capability to make atomic weapons, but he was not sure about Israel's intentions.[88] During an interview with an Iraqi reporter on 20 February 1966 Nasir emphasized that "preventive action" was the first Arab line of defense against the Israeli atomic threat. He said: "If Israel proceeds with the production of am atomic bomb then I believe the only answer to this is a preventive war".[89] Two months later in an American television interview, Nasir again threatened a "preventive war," if it could be conclusively proven that Israel was developing atomic weapons.

> They have a reactor, 24 megawatt, and they have the plutonium. What would be the result? The result would be to produce atomic weapons.[90]

A month later in a British television interview for British viewers, Nasir repeated the preventive war message, adding that Egypt was now considering developing nuclear weapons because Israel was developing nuclear technology.[91] The issue of preventive war before Israel would achieve nuclear weapons capability was repeated again over Radio Cairo on both 9 September and 9 December 1966. On 9 September the broadcast mentioned the possibility of American guarantees that Israel would not resort to atomic weapons built with its own reactor. This is a questionable guarantee, given Israel's control over US inspections of the Dimona reactor.[92]

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[86] Ibid., p 90; Bhatia, op. cit., p 53.

[87] Hedrick Smith, "Soviets Said to Offer Cairo Atom Defense," New York Times, 4 February 1966, pp 1, 12.

[88] Khalil Shikaki, "The Nuclearization Debates: The Cases of Israel and Egypt," Journal of Palestine Studies, Volume 14 number 4, Summer 1985, p 84.

[89] Hedrick Smith, "Warning on Bomb Given by Nasser," New York Times, 21 February 1966, p ??

[90] "Nasser Threatens to War on a Nuclear-Armed Israel," New York Times, 18 April 1966, p 6.

Although Nasir had fired Hedayat in 1964, he reportedly supported Hedayat's covert attempt to develop a complete nuclear fuel cycle from 1965 to 1970, under the cover business, Design Consultants Agency. Defense Minister Marshal Abdel Hakim Amer also supported Hedayat's goal of developing a weapons capability. Egyptian scientists working overseas and in the AEE were recruited into DCA, and the organization was government-financed. The extent of government funding is not known. The AEE jealously competed with this program and described Hedayat's proposals as unfeasible. Hedayat's proposals included a uranium extracting plant, a plutonium-yielding power reactor and a waste fuel reprocessing facility.[93] DCA's existence is not mentioned by any other authors in the literature, so it must have been a well-kept secret.

In December 1966 Economist Intelligence Unit reported that Kuwait had donated one million US dollars to Egypt "to be used in any way the president saw fit." Reportedly this money would go to Cairo University for "practical" modern scientific equipment. It could have been allocated to the AEE.

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[91] United Press International, "Nasser Cites Need for Nuclear Arms," New York Times, 9 May 1966, p 8.

[92] Evron, op. cit., pp 24-25, 29.

[93] Bhatia, op. cit., pp 56-57.

7. Intra-Elite Power Struggle

It is instructive to examine Nasir's balancing of the factions within the former Revolutionary Command Council. Marshall Amer became first official Vice President in March 1964. The Arab Socialist Union (ASU) became a threat to Nasir after Ali Sabri was appointed Secretary General of the party in March 1965. By May 1967 the High Commission on the Liquidation of Feudalism released its initial report correcting the unequal application of land reforms in Egypt. The report effectively sanctioned selected wealthy landowners' resistance to the land reform laws which had been passed to date, and weakened the other rural classes' expectations of socialist reforms. Nasir had appointed the commission as a response to public outcry over the alleged murder in May 1966, of a nouveau riche landowning villager by his aristocratic rival. Egyptian village society had adjusted to three increasingly severe land reform laws, in 1952, 1956 and 1961, with the pre-revolutionary elites retaining most of their political control. Nasir's decision to convene a commission and appoint Marshall Amer undermined the authority of the Arab Socialist Union, under whose jurisdiction this matter should have been investigated, functionally. The HCLF's year-long proceedings demonstrated to the regime elites in both the ASU and the army, that the President was more concerned with weakening potential political rivals than with pressing his socialist modernizing agenda. The findings of the HCLF report, and Nasir's subsequent dismissal of the report after the June War, weakened morale in both the Egyptian army and in the ASU, and showed that Nasir was not serious about land reform after all.[94] This intra-elite power struggle is an example of Nasir's attempt to discredit the ASU and neutralize the army in 1966 and 1967.

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[94] Hamied Ansari, Egypt: The Stalled Society, Albany New York: State University of New York Press, 1986, pp 97-151.

Nasir's treatment of the Atomic Energy Establishment in the mid-1960's is remarkably similar to his political employment of the ASU. The ASU was a mass state political party created in 1962 in order to mobilize political support, because the earlier attempts had failed.[95] Contrary to the earlier two parties, the ASU was given more political power by its structure and Nasir's intent. When the ASU proposed in 1965 more radical socialist reforms than Nasir had endorsed, including ASU control over the army, Nasir faced a genuine political threat to his military supported regime. As a result, Nasir first created watchdog agencies and finally discredited the ASU leadership in 1968.

The AEE was not functionally a political mobilization tool, but it could have allied with those former Free Officers opposed to Nasir's policies. Hedayat used his position as the Minister of Science Research, chairman of the Atomic Energy Board and Director General of the AEE, to expand the organization to include administratively incorporating the AEE under the Ministry of Scientific Research. Hedayat, being a former military officer, favoring military applications of nuclear technology, would have posed a natural threat to ally with other military officers with or without Marshal Amer, in opposition to Nasir.

During the period 1962-1963, the Presidential Council was established to restore presidential power over the military. Marshal Amer resisted this until Nasir relented and the Presidential Council was dissolved in March 1964. Marshal Amer was appointed First Vice President. Kamal al-Din Husayn, and Abd al-Litaf Baghdadi, members of the Presidential Council, resigned in opposition to Nasir's yielding to Marshal Amer.[96] According to Moore, Colonel Salah Hedayat was a protege of Kamal al-Din Husayn.[97] This may entirely explain why Nasir relieved Hedayat of his duties in 1964 and assigned someone outside the inner circle of five former Free Officers, less threatening to Nasir, to temporarily supervise the AEE. Disregarding his alliance to Kamal al-din Husayn, Hedayat remained a threat to ally with other Free Officers opposed to Nasir. Later in the October 1965 reorganization of the government, Marshal Amer was probably given supervision of the AEE. At that time, Ali Sabri, the ASU chief, was excluded from the inner core of five former RCC men at the top of the regime.[98] This rapid succession of three officers to supervise the AEE during 1964-1965, demonstrates that a Free Officer in charge of the AEE was viewed as a political threat to Nasir.

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[95] The Liberation Rally, January 1953 and the National Union, January 1956.

[96] Dekmejian, op. cit., p 182.

8. The Setback

The Egyptian loss of the 1967 War forced Nasir to remove the military from domestic political control and to rearm the military conventionally. Did this mean cutting back on the AEE and DCA budgets also? Bhatia believes that government funding was frozen for such projects.[99] Dr. Mohamed Azat Salama, Minister of Education, was appointed the new chairman of the Board of Atomic Energy in 1967, probably as part of Nasir's government reorganization after the war. El Gubaily continued as Director-General of the AEE. If changing the leadership position is any indicator of Nasir's commitment, then he remained committed to weapons applications. Nasir periodically reshuffled his government cabinet to demonstrate publicly his commitment to develop Egypt despite corrupt, unreliable or inefficient high administrators.

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[97] Moore, op. cit., p 89.

[98] Dekmejian, op. cit., p 182.

[99] Bhatia, op. cit., p 57.

Immediately after the war Nasir sent his AEE director to China with a personal letter requesting assistance in weapons applications research. This was a most serious attempt to directly obtain weapons applications of nuclear technology. Heikal implies that Nasir feared Israel would use its potential to develop atomic weapons in the post-war negotiations. Nasir reminded Chou of an earlier promise after China demonstrated its bomb, not to "keep a monopoly on this scientific achievement". Chou sympathetically received the delegation, but insisted that Egypt would have to develop this technology without outside help. According to Heikal, there were no hard feelings in Egypt about this decision.[100]

Apparently the decision to transfer nuclear weapons technology as the Soviets did to China in the 1950s, and the French did to the Israelis from 1956-1960, was no longer customary by 1967. The Soviets and the US had been conducting negotiations for some form of non-proliferation agreement since the 1963 Test Ban Treaty. The international context of weapons technology transfer had changed by 1967 to the point were China, a relative pariah state which refused to sign the 1968 NPT, still would not transfer weapons technology to an ally in the international non-aligned movement.

A look at Chinese economic aid to Egypt over the period 1956 to 1968 underscores Mao's refusal and the extent of Nasir's desperation, for technical nuclear assistance. Table 5 summarizes economic aid to Egypt, other Middle East regional states and North Vietnam for comparison. Communist Chinese economic foreign assistance is inconsistent to every state but North Vietnam during this period. Aid to Egypt shows a curious surge in 1964 at the peak of Egyptian financial commitments to nuclear technology development. One explanation for this is that the new Chinese foreign economic aid policy announced in January 1964 obliged China to provide unprecedented support to Egypt, in order to "win" other African non-aligned nations from Soviet influence. This aid could have included Egyptian scientists training in mainland China during the year China exploded a bomb. This surge may reflect Nasir's attempt to improve relations with Mao in 1964, when Mao could provide advanced nuclear technologies such as waste reprocessing. Nasir's approach to a state who had cut off economic aid for three consecutive years indicates the lengths to which he was willing to go for nuclear weapon technology.

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[100] Heikal, 1973, op. cit., p 313.

TABLE 5. COMMUNIST CHINESE ECONOMIC AID TO SELECTED STATES (in millions of dollars)[101]

Year	Egypt	Algeria	Syria	Yemen	Pakistan	North Vietnam
1955	n/a	n/a	n/a	n/a	n/a	200.0
1956	4.7	-	-	-	-	-
1957	-	-	-	-	-	-
1958	-	-	-	12.7	-	-
1959	-	-	-	0.7	-	100.0
1960	-	-	-	-	-	-
1961	-	-	-	-	-	157.0
1962	-	1.8	-	-	-	-
1963	-	50.0*	16.3	0.2	-	-
1964	80.0	-	-	28.5	60.0	-
1965	-	-	-	-	-	110.0
1966	-	-	-	15.0	-	170.0
1967	-	-	21.0	-	9.0	225.0
1968	-	-	-	12.0	40.0	200.0

- Negligible or Zero
n/a Not Available
* Interest Free Loan

Sources: (1) Japan External Trade Organization, "How To Approach the China Market," 1972;
(2) Alexander Ekstein, "Communist China's Economic Growth and Foreign Trade," 1966
(3) US Congress Joint Economic Committee, "An Economic Profile of Mainland China," 1968 and "Peoples Republic of China: An Economic Assessment," 1972.

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[101] S. K. Gosh and Sreedhar, "China's Foreign Aid Program," from Gosh and Sreedhar, eds., China's Nuclear and Political Strategy, New Delhi, Young Asia Publications, 1975, pp 161-166.

From 1967 to 1970 many Arab publications were written about the Israeli bomb potential but no significant outbursts of preventive war or development of an Egyptian capability, came from Nasir or Heikal, as in 1961 and 1966. The Arabic books published on this subject in Cairo during this period include: (1) Effects of the Atomic Weapons on International Relations and Strategies of Force, 1967, (2) A Brief Study of the Israeli Military Establishment, 1968, (3) A Look at the Danger, 1968, (4) Israeli Nuclear Policy, 1970, and (4) a revision of number one above in 1971. The books published in Beirut may have been less influenced by the government and more critical of the Arab position: (1) Secrets of the Israeli Military, 1969, (2) Israel: A Military Society, 1971, and (3) Israel and Nuclear Weapons, 1971, also published in English. These works suggested that Israel possessed between 26 and 61 kilograms of plutonium, sufficient for six bombs, and that Israel had both missile and aircraft delivery vehicles.[102]

This sudden outpouring of Arabic publications on the subject and Nasir's own silence makes sense if Nasir had diverted his emphasis from Egyptian atomic capabilities to rebuilding conventional armed forces capability. Marshal Amer had promoted a politically-reliable senior officer leadership incompetent to lead in battle. Before 1967 Nasir depended upon the army to remain loyal to him and to guard against any counter-coups. After 1967, Nasir created a presidential guard force to strengthen his defense against a possible coup. He attempted to depoliticize, and professionalize the officer corps to be able to fight in combat effectively. Nasir's emphasis on conventional equipment from the USSR and training from Russian technicians from 1968 to 1970 and his public silence about an Israeli atomic threat which even the Arabic intellectual world in Beirut could not ignore, suggest a change in support for the Egyptian Atomic Energy Establishment. Shikaki suggests that Nasir hoped after the 1967 war to use the NPT Treaty to contain Israel's unconfirmed weapons program.[103]

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[102] Shikaki, op. cit., pp 84, 90.

In June 1969 Egyptian scientists were telling western journalists publicly that Egypt had decided not to compete in the regional nuclear arms race.[104] Egyptian infrastructure included the Inchas primary research center, eleven laboratories at the Cairo Regional Isotope Center, and Alexandria University Institute of Nuclear Engineering. In December 1969, the Soviets transferred 80 grams of plutonium to Egypt under the terms of a bilateral transfer agreement.[105] As Egypt's research reactor used natural uranium, this transfer indicates Egypt's continued interest in advanced nuclear technology, whether for civilian or military uses. Sometime in 1970, India extended the cooperation begun in 1957 with an agreement to perform joint research in heavy water production, fuel fabrication, and raw-materials extraction.[106] All three of these aspects are dual-use technologies with civilian power and possible military weapons applications.

Colonel Muammar Qadaffi visited Nasir shortly after his rise to power in September 1969.[107] During the strategic military review of the Arab-Israeli conflict, Nasir admitted that the Israelis probably possessed nuclear bombs and that Egypt did not. Three months later Qadaffi's Prime Minister, Major Abdul Salaam Jalloud, consulted with Nasir on his way to Peking to buy a "tactical atomic bomb." Nasir responded that atomic bombs were never for sale but allowed Jalloud an Egyptian passport in order to make the trip incognito. Chou En-Lai refused Jalloud's personal request just as he had refused El Gubaily's mission presenting Nasir's personal request in 1967. While China would provide research support (whatever that meant), the actual weapons production would have to be done unassisted - every nation must be self-reliant in this matter.

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[103] Shikaki, op. cit., p 86.

[104] Cooley, June 1969, op. cit., pp 1,4.

[105] Congressional Research Service, 1982, op. cit., p 294.

[106] Bhatia, op. cit. p 59.

[107] Mohamed Heikal, The Road to Ramadan, New York: New York Times Book Company, 1975, pp 76-77.

Nasir encouraged Hedayat's attempts to develop a joint Egyptian-Libyan nuclear fuel cycle capability. When Nasir agreed to form a joint Federation with Libya in 1970, Hedayat was appointed Federation Minister of Scientific Cooperation.[108] Apparently Qadaffi wanted results quicker than Hedayat could promise, and Nasir did not feel inclined to pool his scientific infrastructure with Qadaffi's money for a joint project. The new Egyptian-Libyan alliance was an alliance of unequals and Nasir could have attempted to extract a financial commitment from Qadaffi, but apparently did not.

The evidence to support the weak state hypothesis is strengthened during the period 1964-1967. The contrast of the institutional turmoil of the AEE under five successive chiefs (Hedayat, Deputy Premier Rifaat, Marshal Amer[109], Deputy Prime Minister Hussein Sait, and Minister of Education Azat Salama) with Nasir's direct attempts to buy weapons technology from the USSR in 1965 and from the PRC in 1967 underscore the threat that the AEE represented to the President. The Supreme Council for Scientific Research was reorganized to replace Hedayat's Ministry of Scientific Research. Alone, the succession of AEE leaders could possibly be explained by lack of scientific progress, but taken in the context together with declining government budgets and the rivalry with Hedayat's DCA, it becomes apparent that Nasir wanted nuclear capability but not the potential domestic threat to his weak state regime.

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[108] Bhatia, op. cit. p 66.

[109] El Sayed Selim provides the only hint of this supervision by Rifaat and Marshal Amer. This suspicion is not corroborated in the other literature, but it is not inconsistent with other references to AEE leadership succession, nor is it inconsistent with Nasir's political leadership at the time.

The motivational model argues that Nasir wanted to go nuclear at this time. The traditional international security approach explains the attempted outright buying of nuclear weapons in both instances. In the first instance, the Israeli nuclear potential forced Nasir to seek a matching capability, or surrender his role as pan-Arab revolutionary leader. In the second instance, loss of the war and discrediting of Egypt's military capabilities as well as demoralization of the officer corps (Nasir's weakening political support base) were strong influences to seek weapons directly, not invest in them for ten years. Dissuasive conditions during this period are the Israeli precedent of covert preemption of the German rocket program, and Soviet discouragement from acquiring the advanced weapons technology. The traditional approach does not explain why the regime undercut its own agency in one instance and then sought weapons in the next.

9. Economic Defense Burden

The result of the June War which most appreciably affected Egypt's atomic development was the overall economic impact of Suez canal revenues lost. The resulting large foreign deficit destroyed Egypt's chances of receiving the amounts of foreign aid necessary for a nuclear power reactor. According to an American study presented in 1967, a 525-megawatt power reactor was the size necessary for a cost effective plant to drive an agricultural-industrial complex, but the start-up investment was estimated at $300-555 million and annual operating costs were estimated to be $48-75 million.[110] Another cost estimate for a large power reactor start-up in 1966 for Egypt, was $300 million, compared with a defense budget of $437 million.[111] This hints at the relationship of nuclear power costs to conventional military defense budgets.

Egypt was not a likely candidate to go nuclear in order to save money on conventional forces, before 1970. An argument exists for evaluating the economic burden of conventional weapons and the likelihood of going nuclear to get more "bang for the buck". One criterion of an intolerable defense expenditure burden is a spending level of ten percent of gross national product on defense for three consecutive years with a zero or positive rate of growth.[112] The available sources of Egypt's Gross National Product (GNP) and Military Expenditures (MILEX) are of questionable accuracy. However two of the accepted sources provide a comparison basis within each data set. In 1960, US CIA director John McCone estimated the initial costs for a plutonium weapons program to be $50 million. Meyer's zero-base case cost estimate in 1960 dollars is $61 million.[113] Recall the Science Ministry budget in 1964 was 4.187 million Egyptian pounds and the separate AEE budget was 2.255 million Egyptian pounds.

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[110] Edward A. Mason, "An Analysis of Nuclear Agro-Industrial Complexes," from Nader and Zahlan, eds., Science and Technology in Developing Countries, Cambridge: Cambridge University Press, 1969, p 135.

[111] Cooley, June 1969, op. cit., p 4.

[112] Meyer, op. cit., p 65.

[113] Ibid., pp 36-39.

TABLE 6. CONVENTIONAL FORCES DEFENSE BURDEN
(in millions of dollars)

Year	Gross Domestic Investment[114]	Military Exp.[115]	PERCENT GNP MIL Exp/GNP	MILEX[116]	PERCENT GNP
	(base 1965)	(base 1961)		(base 1972)	
1950	--	37.9	3.9 %		
1951	--	46.0	4.7 %		
1952	--	44.1	4.9 %		
1953	--	44.2	4.6 %		
1954	--	57.9	5.7 %		
1955	--	89.9	8.4 %		
1956	--	89.7	8.0 %		
1957	--	66.1	5.5 %		
1958	--	76.8	6.1 %		
1959	--	82.2	6.0 %		
1960	597	102.5	7.0 %		
1961	711	109.8	7.1 %		
1962	664	141.9	8.5 %		
1963	806	208.0	11.0 %	483.7	8.6 %
1964	884			511.7	8.6 %
1965	952			586.7	9.2 %
1966	894			457.6	7.1 %
1967	756			422.0	6.7 %
1968	681			573.6	8.9 %
1969	742			655.7	9.6 %

10. Domestic Arms Industry

The limited science base of Egypt restricted efforts to build rockets and airplanes for the following reasons, according to Zahlan: (1) inadequate university research, (2) over-dependence on foreign technicians, (3) the army project managers did not have adequate technical training, (4) international isolation from similar projects overseas, (5) failed manufacturing quality control, (6) inadequate computer facilities, and (7) absence of in-house staff development and training.[117] Some of these same qualities could be applied to the Egyptian atomic development program under Nasir.

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[114] World Tables 1976, World Bank, Baltimore: Johns Hopkins University Press, 1976, pp 90-91.

[115] Nadav Safran, From War to War, New York: Pegasus, 1969, p 148.

[116] World Military Expenditures and Arms Trade, 1963-1973, Arms Control and Disarmament Agency, Washington D C: US Government Printing Office, 1975, p 31.

By 1969, Nasir's frustration with the Egypt's domestic arms industry must have convinced him to reduce his investment in an atomic research program with uncertain and at best distant-future returns. Domestic arms production had failed for four reasons: (1) insufficient financing, (2) overproduction of Western-modeled items incompatible with Soviet arms imports, (3) the absence of export markets for Egyptian made western-designed items, and (4) intra-elite political rivalries. Nasir's decision in 1964 to make the military factories for-profit government-subsidized corporations, led to a gradual conversion from military hardware to commercial appliances. In May 1969 Nasir abolished the Ministry of Military Production and ordered the conversion of the aircraft factories (with 100 million Egyptian pounds previous investment) into maintenance workshops. In July Nasir announced negotiations with the Soviets for military-industrial assistance.[118] The causes of failure of the Egyptian aircraft industry may help explain the slowed atomic development program. Both required western technology assistance. The 1964 decision to introduce profit as a criteria for military factories coincides with Nasir's reorganization of the leadership of the AEE.

11. Nasir's Legacy

According to El-Sayed Selim, Gamal Abd al-Nasir's regime brought progress in planning and goal setting for civilian energy applications of nuclear technology. However in the process, individual scientific training suffered. Sabet, Zahlan, and Moore all support the argument that politics forced the capable Egyptian scientists to seek professional work overseas rather than develop a nuclear bomb under Nasir. The increasing trend by 1966 of scientists in all fields to emigrate, suggests that the limited research budgets of the command economy since 1961 further restricted by the profit motive after 1964 to produce civilian applications, cumulatively diminished scientific progress within the AEE.[119]

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[117] Zahlan, 1972, op. cit., p 25.

[118] Mohammad El-Sayed Selim, "Egypt," from James Everett Katz, ed., Arms Production in Developing Countries, (out of print) New York: Free Press, 1984, pp 132-134. The 1969 exchange rate for one Egyptian pound was $2.30.

By the time of Nasir's death in September 1970, the Egyptian atomic research infrastructure possessed a small research reactor, some laboratory facilities, research quantities of uranium and plutonium, and an indeterminate but significant pool of scientists trained overseas and in Egypt. The scientists may have received limited experience with waste fuel reprocessing in India. The Soviets refused to transfer weapons-application technology to the scientists trained in Russia. The government had solicited bids for state-of-the-art large power and desalination projects but could not finance them. The originally flexible Soviet nuclear export policy became restricted from export dual technologies after their experience with the Chinese ploy of "nuclear chicken" over the Quemoy-Matsu Islands in 1958.

After 1965 Egypt lost its political support from the US and Germany, two states which might have exported dual use technologies such as a large power reactor. Possibly the global non-proliferation trend and Egyptian financial shortfalls prevented Egypt from acquiring a power reactor for legitimate civilian uses after 1967. Nasir's brightest prospect in competing with the perceived Israeli threat after 1967, was to pursue a policy of ambiguity and secrecy, allowing other Arab leaders and the Arab press to air the issue publicly. The near military coup after the June 1967 War diverted Nasir's attention from countering the Israeli threat to consolidating domestic support, professionalizing the army and creating an elite presidential guard unit.

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[119] Sabet, op. cit., pp 207-210; Zahlan, 1972, op. cit., 1972, pp 17-36; Moore, op. cit., pp 87-90, 97-99.

By 1969 the failed Egyptian military aircraft industry and the failed Egyptian medium range rocket program conditioned Nasir to oppose large investments necessary to develop the atomic research program further. The AEE and Salah Hedayat's DCA were allowed to continue a nominal research effort for training new scientists. Nasir hoped that the DCA would draw funding support from other Arab states such as Algeria, Kuwait, Saudi Arabia and Iraq. As far as facing the Israeli nuclear threat, Nasir would have to rely on the uncertain Soviet nuclear umbrella. Egyptian chemical weapons used in Yemen were not yet fitted to a strategic missile delivery vehicle capable of threatening Israel.

The period from late 1967 to Nasir's death in September 1970 does not give strong evidence for either the weak state hypothesis or the motivational hypothesis. This is the period when the technological hypothesis is suggested to explain the non-event. Supposedly, the high cost of buying a economically feasible power reactor prevented Egypt from being able to finance one. This is true enough taken at face value. But what is not discussed is the cost of building a smaller, 20-30 megawatt reactor, more the scale of the Israeli reactor at Dimona, compared with Egypt's defense budget. Clement Moore's suggestion of intellectual paralysis of the Egyptian scientific community is an alternate technological hypothesis explanation for lack of success. That paralysis, if it existed, can be explained as an outcome of the weak state methods Nasir used to coopt or demote the AEE into his ruling regime elites. Scientists may have avoided producing legitimate research to avoid losing their livelihood as a part of the state.

C. NEW REGIME LEADERSHIP

President Anwar El-Sadat revived the Egyptian nuclear program once he had consolidated power in May of 1971. From 1970 to 1977 the government secretly debated the Egyptian response to Israel's nuclear potential. Those reportedly in favor of developing an Egyptian nuclear capability were Ali Sabri, General Sadek, Ahmed Sidqi, Ismail Fahmy and Mohamed Heikal.[1] This argument was initially couched in terms of Soviet nuclear supply. The pro-nuclear camp argued for either a Soviet nuclear arms delivery capability in Egypt or a Soviet guarantee against future Israeli threats. Sadat did not want to pay the political price of nuclear dependence on the USSR.[2] Sadat initially needed to broaden his appeal and form a new ruling coalition. This led to a formal reversal at first (more for show than function), of Nasir's two programs which were most widely opposed - the socialistic command-economy and the imprisonment of political dissenters. Sadat's gradual appeal to western sources of political and economic support and turning away from the USSR is a more subtle example of this attempt to legitimate his own rule as different than the popular Nasir. As part of this attempt to distance himself from Nasir and broaden his ruling elite coalition, Sadat supported minor government programs which Nasir had discontinued. One example is the abolished Ministry of Military Production, which was restored in 1971.[3] Most likely Sadat initially supported the AEE which had fallen out of political favor after 1964. Supporting an Egyptian nuclear bomb program would have reinforced his appeal to the Egyptian officer corps and those elite bureaucrats who would like to see a stronger Egypt.

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[1] Amos Perlmutter, Michael Handel, Uri Bar-Joseph, Two Minutes Over Baghdad, London: Valentine, Mitchell and Company, 1982, p 33; Etel Solingen, "The Domestic Sources of Regional Regimes: The Evolution of Nuclear Ambiguity in the Middle East," (draft) to be published in International Studies Quarterly, Volume 38, Number 4, June 1994, p 52.

[2] Uri Bar-Joseph, "The Hidden Debate: The Formation of Nuclear Doctrines in the Middle East," Journal of Strategic Studies, Volume 5 Number 2, June 1982, p 207.

[3] El-Sayed Selim, 1984, op. cit., p 135.

1. Science and Technology

Dr. Ahmed Mustafa, the previous Minister of Education was appointed the new chairman of the Board of Atomic Energy sometime in 1970, probably after Sadat became President. El Guibaily remained on as Director General of the AEE. Mustafa's appointment placed a loyalist in charge of this sensitive minor ministry without disrupting the scientific direction of the AEE. The Arab Cooperation Agreement for the Use of Nuclear Energy for Peaceful Purposes became effective in November 1970.[4] This may have forced Sadat into a political stance opposed to nuclear weapons very early in his regime.

Transfers of plutonium from the Soviets in 1969 and 1970 are not addressed in the available literature. Egypt received 16 grams of plutonium from the USSR in November 1970, as part of the existing bilateral cooperation agreement. This is a small amount of plutonium when compared to the amount transferred the previous year, but in light of the greater trend of Soviet exports of fissionable materials reported to the IAEA (Table 7), this suggests a Soviet attempt to influence the new Sadat regime, promising further Soviet assistance.

TABLE 7. SOVIET AND SOVIET BLOCK FISSIONABLE MATERIAL EXPORTS REPORTED TO THE IAEA, DELIVERED THROUGH DECEMBER 1971[5]

Transfer Date	Supplier	Recipient	Quantity	Type Material
Mar, 1964	USSR	Finland	3025 grams	Enriched Uranium
Sep, 1968	USSR	Romania	20 grams	Enriched Uranium
Jan, 1969	USSR	Indonesia	80 grams	Plutonium
Dec, 1969	USSR	**Egypt**	80 grams	Plutonium
Nov, 1970	USSR	Burma	16 grams	Plutonium
Nov, 1970	USSR	**Egypt**	16 grams	Plutonium
Nov, 1970	USSR	**Egypt**	*	Plutonium
Dec, 1970	USSR	Sri Lanka	80 grams	Plutonium
May, 1971	USSR	Singapore	16 grams	Plutonium

* less than 1 milligram

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[4] Jabber, 1981, op. cit., pp 33-34.

[5] Congressional Research Service, 1980, op. cit., pp 294-300.

When Soviet leaders visited Egypt for the Aswan High Dam opening in January 1971, they reportedly offered to supply nuclear power plants.[6] This offer was probably of the light-water-moderated type power reactor, not capable of producing waste products for military use, judging by all previous and succeeding exports. Regardless of the type reactor, Sadat's emerging pro-Western position in early 1971 implies that he would oppose any Soviet offer requiring Soviet technicians to run the plant.

In July 1971, Al-Ahram reported the AEE had fifty scientists working primarily in desalination and the use of peaceful explosions for excavation and petroleum extraction.[7] The Egyptian scientists presented scientific rationale for a civilian nuclear program at the Fourth International Conference on the Peaceful Uses of Atomic Energy in September 1971. At this conference Egyptian papers were presented on the usefulness of atomic power for electricity, desalination, excavation, and natural gas exploration.[8] El Gubaily and company presented significant justifications which were apparently credibly received by the international scientific community. The projected electricity production capacity deficit of 500 megawatts during the period 1976-1980 was to be met with a 300-400 megawatts power reactor. A 50-megawatt, natural uranium, heavy-water-moderated reactor was proposed as the type needed for desalinating water for agricultural, industrial, and civilian demand. The peaceful nuclear explosions (PNE) analysis, supported by geological survey data, expected existing nuclear weapons states to execute PNE service in Egypt under the provisions of the Nonproliferation Treaty.

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[6] John K. Cooley, "Cairo Assessing Nuclear Strength," Christian Science Monitor, 2 January 1975, p 4.

[7] Paul Jabber, "A Nuclear Middle East," from Gabriel Sheffer, Milton Leitenberg, editors, Great Power Intervention in the Middle East, Elmsford New York: Pergamon Press Inc, 1979, p 78.

[8] United Nations and International Atomic Energy Agency, Peaceful Uses of Atomic Energy, New York: UN/IAEA, 1972. El Koshairy, El Gubaily, El Hamamsy, Effat, Taher, and El Fouly, "Possibilities of Introducing and Integrating Nuclear Power in the Egyptian Power System," volume 1, pp 241-256; El Gubaily, Effat, El Fouly, El Kholy, El Meshad, Gaddis, Fouad, Marey, Haroun, Sayed, "Studies for the Potential Use of Nuclear Desalination in Egypt," volume 6, pp 115-130; El Gubaily, El Shazly, Diab, "Prospects of Peaceful Applications of Nuclear Explosions in Egypt," volume 7, pp 233-245.

The civilian electricity findings were corroborated by the IAEA in a market survey performed in September 1973. The AEE later published a paper refuting the economic feasibility of nuclear desalination projects in 1974, after Gubaily had retired from the AEE.[9]

From his perspective as a physics professor at American University in Beirut, Zahlan assessed the Israeli and Arab nuclear capabilities in the spring of 1972. He estimated that Israel either had a nuclear weapon at that time or could produce one within one year. "No Arab State has so far made any serious attempt to acquire the rudiments of nuclear know-how, let alone acquire an option."[10] This contradicts Meyer's analysis of the Egypt's latent capability to manufacture nuclear weapons. He concludes that Egypt possessed the latent technological capability in 1969 (and Israel in 1968).[11] Zahlan was closer to the primary sources, so his critical assessment seems more reliable.

In April 1972 Egypt announced a plan to buy two nuclear power stations of 400 megawatts each. One would come from the USSR for a cost of $70 million, and the other source was not identified.[12] This plan did not come to fruition either.

2. Domestic Politics

The issue overriding all others in the period 1971-1973 was how Sadat would regain the Sinai peninsula militarily. In this strategic context, nuclear weapons would not become available in the short-run and were not a credible threat without conventional force parity with the Israelis. Sadat's new Egyptian Chief of Staff in the May 1971 reorganization was a commander renowned for his professional ability, Saad El-Shazly. The re-professionalization of the Egyptian Army continued with Sadat's requests from the Soviets for high-technology equipment comparable to Israeli military hardware. Sadat decided during this period to revise Egyptian domestic arms production strategy from attempted non-aligned self-reliance to integration with western arms producers for licensed production of selected items.[13] The long-run parallel of this strategy for the nuclear program was to turn away from reliance on the uncertain Soviet nuclear guarantee and the restrictive Soviet nuclear export policy to Western nuclear suppliers. According to one source, the AEE unofficially requested to buy nuclear reactors from American companies after Sadat came to power, but the requests were denied due to the poor Egyptian-US diplomatic relations at the time.[14] In the short-run, Sadat needed the Soviet nuclear umbrella and Soviet conventional arms.

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[9] Bhatia, op. cit., p 58.

[10] Zahlan, 1972, op. cit., p 25.

[11] Meyer, op. cit., p 41.

[12] John K. Cooley, "Egypt Assessing Nuclear Strength," Christian Science Monitor, 2 January 1975, p 1.

In January 1972 Sadat declared publicly that Egypt would seek "retaliatory" offensive weapons from the Russians.[15] The definition of retaliatory was purposely left vague enough to include conventional jets or long-range missiles. In March, the decision to develop Egypt's domestic arms industry was made public.[16] As part of the large Soviet arms buildup between December 1972 and June 1973, Egypt received a shipment of SCUD-B surface-to-surface missile launchers capable of hitting Israeli population centers from the west bank of the Suez Canal.[17] In addition to the new missile launchers shipped for Egyptian units, a Soviet-manned separate detachment of SCUD-B launchers was operational by August 1973. With the arrival of these missile launchers, Egypt finally possessed a delivery vehicle capable of threatening Israeli population centers - the first credible strategic capability to counter Israel's demonstrated superior air and missile capability.

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[13] El-Sayed Selim, 1984, op. cit., pp 135-140.

[14] El-Sayed Selim, 1982, op. cit., p 140.

[15] William Dullforce, Egypt Asks Russians For 'Retaliatory' Arms," Washington Post, 26 January 1972, pp 1, 18.

[16] "Sadat Says Egypt Will Produce Arms," Washington Post, 17 March 1972, p 22.

3. Indian Assistance

In September 1973 an IAEA survey reported Egypt's nuclear power requirements of 400 megawatts capacity by 1980 and 400 megawatts additional capacity by 1982.[18] (This survey was based upon over-optimistic cost projections. The IAEA estimated the reactor cost to be $460 per kilowatt-hour (kWh), while Egyptian estimates ranged from $225 to $390 per kWh. Later Egyptian estimates in 1983 ranged up to $5000 per KWh.[19]) In 1973 Egypt requested help from India to build a 50-megawatt desalination plant.[20] If this is the same required desalination reactor described in the 1971 IAEA conference documents, this would have been heavy-water moderated, and may have provided small but militarily significant quantities of nuclear waste material. The Indian connection seems to have been potentially the most likely source for dual-use nuclear technology imports. At that time, India's advanced indigenous nuclear fuel cycle capability and its non-aligned international political status raise the question of why India did not share dual-use technology with the Egyptian scientists. India's NPT non-signatory status included a past official position against exporting dual-use applications of nuclear technology such as waste reprocessing.[21] According to Bhatia, the Egyptian request for a 50-megawatt desalination reactor was withdrawn in 1974, for fear of jeopardizing initially successful contacts with the US for a much larger power reactor.

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[17] Joseph Burmudez, "Egypt's Missile Development," (draft) from William C. Potter and Harlan W. Jencks, editors, The International Missile Bazaar: The New Suppliers Network, Boulder Colorado: Westview Press, 1993 (pending final publication) pp 28-29. According to Michael Brzoska and Thomas Ohlson, (Arms Transfers to the Third World, 1971-1985, Oxford: Oxford University Press, 1987) it is unconfirmed that SCUD-B launchers (12) and missiles (60) were ordered in 1972 and delivered in 1973.

[18] Nashif, op. cit., p 28.

[19] Gregory H. Kats, "Egypt," from Jozef Goldblat editor, Non-Proliferation: The Why and the Wherefore, London: Taylor and Francis, 1985, p 186.

[20] Bhatia, op. cit., p 59.

The period from Nasir's death to the eve of the Yom Kippor War presents inconclusive evidence for either the weak state hypothesis, the motivational hypothesis, or the technological hypothesis. This was a period of transition, in which Sadat probably allowed continuation of preceding levels of research and development in order not to upset the fragile regime coalition. What is unanswered in available literature is the degree of Egyptian scientific links with India at the time when India was proceeding quickly toward making a peaceful explosion device. Long historical ties with the Indian program imply a probable connection. Strong motivational conditions are present in the form of Arab regional prestige, and loss of a war, but these appear to have been satisfied by pursuit of conventional weapons capabilities. The Soviet nuclear guarantee likely provided a strong dissuasive element in Egypt's motivational profile. The newness of the NPT regime did not restrict other foreign nuclear suppliers as much as the political isolation of Egypt under Soviet alliance, which supports Sadat's attempted breaking out of this isolation by ejecting Soviet advisors in 1972. The Egyptian representatives at the 1971 UN/IAEA conference demonstrated some degree of technical capability in the AEE, but Egypt's foreign technology dependence was clearly implied in the presentations. The PNE capability was sought from foreign sources under the guise of the NPT. Together with Zahlan's assessment of this period, the technological hypothesis explains why Egypt had not developed a weapons capacity in this period of Egypt's nuclear development history.

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[21] Rodney W. Jones, "India," from Jozef Goldblat, editor Non-Proliferation: The Why and the Wherefore, London: Taylor and Francis, 1985, pp 101-105.

4. Public Demand for Weapons

One month after the Yom Kippor War cease-fire, before the Egyptian and Israeli armies had disengaged from their war-fighting positions across the Suez Canal, Mohamed Heikal again raised the nuclear arms issue publicly in his weekly editorials on 24 November and 14 December, 1973. He stated alternately that Israel either possessed three bombs, or was at least capable of producing them within six months. Heikal suggested the Arabs must develop a collective weapons program, and that this subject should be discussed at the upcoming Algiers Summit. The requirements for an Arab joint program were: (1) an Arab supervisory committee, (2) one hundred scientists, (3) "some $500 to $750 million" to establish an atomic center somewhere in the "strategic depth" of the Arab world far away from any Israeli threat, and (4) access to existing scientific facilities throughout the Arab world. This is the first public reference to Egypt's attempted nuclear arms development program prior to 1967, Egypt's attempt to buy nuclear arms from the Chinese after the June 1967 War and Qadaffi's attempt to buy nuclear weapons in 1970.[22]

Two weeks later after the Algiers Summit had convened, Heikal again declared the need for a joint Arab nuclear deterrent to Israel. Either the summit meetings did not result in a plan of action which suited Heikal's pro-nuclear stance, or he attempted to bolster the long-term commitment necessary for developing an advanced technology.

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[22] William Dullforce, "Key Egyptian Urges Arabs to Get or Make Atom Bomb," Washington Post, 24 November 1973, pp 1,13.

> I earnestly hope that this subject be taken seriously, and that we prepare for it, with the foreknowledge that the use of nuclear weapons is fraught with enormous dangers, but also aware that our struggle with Israel - despite all that may be said about the upcoming peace conference - is a long, long, long struggle, and that this struggle may witness moments of madness that should not catch us by surprise. Moreover, if the Arab Nation truly aspires to an influential world role, this it cannot attain without an independent nuclear umbrella. This has been well understood by both China and France - and I daresay India and Japan as well, given their preparedness to build the bomb within months once a political decision has been taken.[23]

Heikal was fired from his position as editor of Al-Ahram in early 1974.[24] This is the first indication that Sadat would not adopt the pro-nuclear weapons policy being advocated by Heikal and Fahmy.

D. RAPPROACHMENT TO THE WEST

1. U.S. Cooperation

Sadat decided to approach the West alone, without Arab funding. The Egyptian-American nuclear cooperation negotiations lasted four years, from initial secret contacts in January 1974 to the 1978 Congressional Nonproliferation Act. In the end, US Congressional pro-Israeli and non-proliferation sentiment and Egyptian negotiation strategy thwarted a deal which seemed likely at the start. Between January and June 1974, the American Atomic Energy Commission secretly negotiated separately with both the Egyptian AEE and the Israeli Atomic Energy Commission. On 18 May 1974 India successfully tested a peaceful nuclear explosion. Egyptian scientists may have been present at the Indian testing grounds during this explosion.[25] If so, this could have increased the political support for the weapons capability within the ruling elite surrounding Sadat as well as within the AEE. On 14 June, President Nixon and President Sadat announced a joint agreement for improved economic and diplomatic relations including agreement to sell nuclear reactors and fuel (unspecified) to Egypt. This single initiative, promising access to advanced western technology, is the watershed event symbolizing Egyptian reentry into western politics. Although it subsequently failed its ultimate goal, this event symbolized the western recognition of Egypt's need for assistance for industrialization, at a point in time when Soviet industrial support appeared restrictive.

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[23] Paul Jabber, Not By War Alone, Berkeley: University of California Press, 1981, p 34; from Al-Ahram, 14 December 1973.

[24] Jabber, 1981, op. cit., p 34.

[25] Feldman, op. cit., p 73.

On 27 June Egypt paid a $660,000 down-payment for nuclear fuel enrichment services to be provided for a future US-supplied power reactor. The formation of the Arab Energy Institute 11 July, intended to develop indigenous Arab science programs for nuclear and solar energy, indicates the symbolic importance which was attached to the Nixon-Sadat statement of bilateral relations.and complimented the drive toward Arab nuclear self-sufficiency.[26] US Congressional hearings held from June through September recommended stringent safeguards for the proposed 600-megawatt reactors and 4 percent enriched uranium sales including clauses that would require all fuel fabrication and waste reprocessing be performed outside Egypt and Israel, and that both Egypt and Israel should either sign the NPT immediately or place all its existing facilities under IAEA safeguards.[27]

2. Nonproliferation Posture

Sadat followed a wide-ranging strategy on the issue of proliferation and Egyptian nuclear development during his most popularly-supported period immediately after the 1973 war. He attempted to capitalize on the Egyptian political victory of the war. Egypt and

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[26] Henry Tanner, "Arabs to Set Up Energy Institute," New York Times, 12 July 1974, p 50.

[27] Hearings before the Subcommittees on International Organizations and Movements and on the Near East and South Asia of the Committee on Foreign Affairs, House of Representatives, U. S. Foreign Policy and the Export of Nuclear Technology to the Middle East, June 25; July 9, 18; and September 16, 1974, Washington: U. S. Government Printing Office, 1974, pp vi-viii.

Iran sponsored United Nations Resolution 3263 (XXIX) for a Middle East Nuclear-Weapons-Free Zone (NWFZ) in July and August, in the United Nations General Assembly.[28] Karem suggests that Egypt decided to cosponsor the NWFZ proposal to soften US congressional criticism of the proposed reactor sale to Egypt and Israel. Egypt decided to cosponsor the resolution only after getting Iran to agree to change the title of the proposed agenda item from "Establishment of a Nuclear Free Zone" to "Establishment of a Nuclear Weapon Free Zone," to permit continued development of civilian applications of nuclear power. The resolution did not focus upon Israel's suspected capability. It was approved by a roll call vote on 9 December, 128 votes for to none against, with Israel and Burma abstaining. The two key points of the resolution are:

> . . . considers that . . . it is indispensable that all parties concerned in the area proclaim solemnly and immediately their intention to refrain, on a reciprocal basis, from producing, testing, obtaining, acquiring or in any other way possessing nuclear weapons;
> . . . calls upon the parties concerned in the area to accede to the Treaty on the Non-Proliferation of Nuclear Weapons.

The American congressional opposition to the Nixon-Sadat initiative led Egypt to continue seek a power reactor from other sources. Sometime during 1974, Egypt initiated secret talks with France's Technicatome company to upgrade the Inchas research reactor from 2 megawatts to 10 megawatts.[29] Alternately, in November 1974, Egypt's Foreign Minister announced that the Soviets had unofficially agreed to provide a 460-megawatt power reactor and that the agreement would be signed during Brezhnev's visit in January 1975. Brezhnev's visit was postponed and the initial Soviet agreement was not mentioned again.[30] The Egyptian acceptance of the Soviet nuclear umbrella must have been communicated to Moscow during the American debate on providing reactors to Egypt and Israel. In December 1974, the Soviet nuclear umbrella was reaffirmed by Arab diplomatic sources to protect Syria, Egypt, Iraq, and Algeria "if it is proved that Israel possesses atomic weapons".[31]

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[28] Mahmoud Karem, A Nuclear-Weapon-Free Zone in the Middle East: Problems and Prospects, New York: Greenwood Press, 1988, pp 91-100, 137-139.

[29] Bhatia, op. cit., p 60.

[30] John K. Cooley, "Egypt Assessing Nuclear Strength," New York Times, 2 January 1975, p 1; also El-Sayed Selim, 1982, op. cit., p 141.

The attempted use of nuclear power exports to facilitate the Egyptian-Israeli disengagement accords failed. Sadat responded to Congressional recommendation for IAEA inspections, with a counter-proposal that both Israel and Egypt submit all previously built reactors to IAEA inspection. Whereupon Israel withdrew support for the proposal, effectively vetoing the Nixon plan. Sadat reacted by recalling the stalled disengagement negotiations and Israel's possession of nuclear weapons.

> We shall not be scared or intimidated and if Israel is going to bring atomic weapons to this area we shall also find a way to having atomic weapons. But we shall not start and we shall not be the first to use atomic arms.[32]

In January 1975, Egypt conducted negotiations with the French for two power reactors, with purported Iranian or Saudi financing.[33] On 7 August 1975, following warnings to Israel against introducing nuclear weapons into the region, Sadat formed the Higher Council for Nuclear Energy (HCNE).[34] HCNE members included Sadat, Vice-president Mubarak, Foreign Minister Ismail Fahmy, War Minister Abdel Ghani Gamasi, the prime minister, minister of electricity, and the chief of the General Intelligence Agency. Only the electricity minister had some technical expertise. This was a political body to set national guidance for the nuclear development project. The council held its first meeting in

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[31] "Soviets Said to Give Arabs Atom Pledge," New York Times, 4 December 1974. p 14.

[32] John W. Finney, "Sale of Reactors to Egypt and Israel is Now in Doubt," New York Times, 17 December 1974, pp 1,4; "Mideast Ready to Explode, Sadat Says," New York Times, 17 December 1974. p 4.

[33] Nashif, op. cit., p 28.

[34] "Egypt," EIU, number 3, 1975, p 5.

September 1975, affirming the earlier proposals to build the first power reactor at Sidi-Krier.[35] The HCNE bears striking resemblance to the Supreme Committee for Armament (SCA) established to supervise the Egyptian arms industry contribution to the Arab Organization for Military Industries (AOMI). The SCA consisted of the President, Vice-President, War Minister, Foreign Minister, Chief of General Intelligence Agency, Finance Minister and Minister of State for Military Production. Although the SCA and the AOMI were separate from the Egyptian and Arab nuclear development organs, the pattern of reorganization to achieve a new goal indicates a change in state policy.

By establishing a new ministry in name, Sadat intended to effect a policy change, from importing western technology on a turn-key basis, to licensed reproduction of foreign technology, eventually leading to Egyptian- designed weapons. The formation of the HCNE signals a shift in Sadat's nuclear development strategy ostensibly for peaceful purposes only, in August 1975. This shift may only have been a diversification of nuclear technology suppliers, renewed covert drive for weapons development, or a reconciliation to peaceful-use-only applications.

In order for Sadat to receive western economic and military aid he had to convince the Americans that Egypt would not develop nuclear weapons. In November 1975, continuing negotiations with the Americans led to a revision in the American conditions which Sadat found acceptable. These conditions included the old provisions of IAEA inspection safeguards and obligation to reprocess, fabricate and store nuclear fuels outside Egypt. The Egyptians dropped the insistence of applying the Israeli reactor at Dimona to IAEA safeguard inspections, accepting such safeguards for future reactors only. Egypt would receive two 600-megawatt power reactors at a total cost of $1.2 billion. President Ford requested $750 million for economic aid to Egypt, obliquely related to this request.[36] The following month Sadat announced a Franco-Egyptian arms development program including export of French nuclear power plants.[37] This was the first public announcement of French nuclear assistance to Egypt, made after the US cooperation agreement had been signed.

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[35] El-Sayed Selim, 1982, op. cit., p 145.

3. Peaceful Applications Only

In February 1976, the Egyptian newspaper Al-Ahram announced the plan to build ten nuclear power stations in the next 20 years. The first of these plants would be built by one of two American firms bidding on the project at the time, Westinghouse and General Electric. In March 1976 a new organization was grafted from the AEE specifically for the purpose of negotiating, purchasing, and operating nuclear power plants, the Nuclear Power Plants Authority, (NPPA). The NPPA worked for the Minister of Electricity, Ahmed Sultan. The AEE and the Board of Atomic Energy remained functionally separate but in fact were headed by the same man, Dr. Kamal Effat, responsible to the President.[38] At this time the Minister of Electricity appears to have gained the upper hand in the bureaucratic infighting. By 1978 both the Board of Atomic Energy and the AEE were placed under the Ministry of Electricity.[39] The Minister of Electricity announced Egypt's nuclear power purchasing strategy of buying first from the US and then from France and West Germany in order[40].

There are two ways of interpreting the creation of the NPPA in March 1976. One is that the AEE, frustrated by lack of regime suport, demonstrated potential to join an anti-regime military coalition, which led to Sadat to weaken the AEE by placing the NPPA under a separate ministry. The second is that Sadat realized he would have to cooperate with western non-proliferation measures in order to obtain western eocnomic aid. The nuclear export restrictions of the London Nuclear Suppliers Group, an unofficial nuclear export cartel formed in spring of 1975, must have been made clear in ongoing US-Egyptian negotiations.[41]

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[36] Bernard Gwertzman, "Nuclear Accord With Egypt Seen," New York Times, 1 November 1975, pp 1,5; El-Sayed Selim, 1982, op. cit., pp 141-142.

[37] Reuters, "France Will help Egypt Make Arms," New York Times, 15 December 1975, pp 1,6.

[38] Bhatia, op. cit., p 53; El Sayed Selim, 1982, op. cit., pp 146.

[39] Bhatia, op. cit., p 53.

[40] Nashif, op. cit., p 29.

Egypt turned to Communist China again in April 1976 for economic and military trade, including arms trade and potential nuclear technology trade.[42] The Chinese leadership was in transition after Mao's death and the PRC provided a wide range of potential economic an military supplies to replace Soviet trade. Chinese nuclear export policy likely remained unchanged from Mao's time. Sadat did not choose to exploit this source but rather used its potential to keep his options open if American support evaporated after the Presidential elections in November.

4. Israeli Nuclear Threat

Egyptian officials were not silent on the Egyptian-Israeli nuclear competition during this period. This may reflect intra-elite tension for and against developing a nuclear weapons. In May 1976 Foreign Minister Fahmy reiterated the challenge that Egypt would get the bomb if Israel became an overt nuclear power. The announcement from a member of the SCA and the HCNE, not the President, suggests increase in leadership commitment to an Egyptian bomb. A Presidential statement could be interpreted as rhetorical posturing for foreign or domestic purposes. Of note in this statement is Fahmy's reference to Egyptian scientific capability.

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[41] Roger F. Pajak, Nuclear Proliferation in the Middle East: Implications for the Superpowers, Washington: National Defense University Press, 1982, pp 21-22; The original members, the USSR, US, Canada, Japan, Britain, France, and West Germany were later joined in 1977 by Belgium, Italy, the Netherlands, Sweden, Switzerland, East Germany, Poland, and Czechoslovakia.

[42] "Chinese Meet With Egyptian Seeking Arms," Washington Post, 20 April 1976, p 12.

> If Israel explodes an atomic device, Egypt will obtain a similar weapon or manufacture it. We have scientists capable enough to mount a reaction in this field, and there are no scientific or technological barriers in our way.[43]

On the other hand, this could be seen as a tacit agreement to refrain from developing nuclear weapons as long as Israel did not demonstrate its long-suspected weapons capability.

The AEE continued attempts to import weapons technology. Sometime in 1976 Egypt approached the French firm Technicatome again with a request to increase the capacity of the research reactor at Inchas to 10 megawatts, and to build a fuel fabrication plant. The firm initially responded with a proposal of 50 million francs, quite possibly within Egypt's budget, but withdrew the offer under pressure from the French government.[44] A fuel fabrication plant is a more direct indication of capability to build a nuclear bomb. This indicates the competing interests to acquire weapons technologies during public overtures of non-proliferation compliance.

Information of the Egyptian strategic chemical weapons capability was reported less than six weeks later.[45] According to this report, Egypt possessed a strategic chemical weapons capability as early as before the 1973 War. The capability was described as nerve gas deliverable by either SCUD-B missile or by aircraft. At least one such operational air force unit was so equipped, but never deployed during the war, possibly reserved as a strategic deterrent. War Minister Gamasi confirmed this on 14 October 1976, declaring "Egypt has enough of the other types of weapons of mass extermination and it has the capability of retaliating against an Israeli nuclear blow by making use of these weapons".[46] Sadat's possession of a chemical counter-value deterrent in 1973 did not preclude his subsequent continued pursuit of nuclear technologies with both civilian and military potential.

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[43] "Egypt to Get A-Bomb if Israel Explodes One," Washington Post, 1 May 1976, p A9.

[44] Bhatia, op. cit., pp 60-61.

[45] William Beecher, "Egypt Seen Set to Use Nerve Gas," Washington Post, 6 June 1976, p A14.

5. Civilian Uses

The ongoing negotiations with the US led to Egyptian and Israeli approval of an interim cooperation agreement 4 and 5 August 1976, pursuant to a final agreement in 1978. The Egyptian proposal was for two reactors of 1280 megawatts capacity and the Israeli proposal for two reactors of 1970 megawatts. The agreement was not yet readied for approval by President Ford or the Congress.[47] An Egyptian letter of intent was submitted to Westinghouse for the first 600 megawatt reactor at Sidi Krier.[48] El-Sayed Selim suggests that the negotiations were delayed by US elections. No further official US action was taken until mid-1979. The US refused to go further than preliminary coordination and planning because Egypt refused to ratify the NPT.

It was reported in April 1977 that Egyptian scientists were being trained at India's Trombay research center.[49] At Trombay, Egyptian scientists could have received training in chemical waste reprocessing. In June 1977, after President Carter announced a more restrictive non-proliferation policy reversing the liberal Nixon-Ford export policy, Sadat announced Egypt's plan to buy four or five power reactors from France. In the interview Sadat implied that the Egyptian agreement for two reactors from Westinghouse remained in effect.[50] The Egyptian organizational structure was again revised in 1977. The AEE's geology department was split off to form the Nuclear Materials Corporation (NMC). The NMC was attached to the Ministry of Trade and remained responsible for geological surveying and nuclear resources extraction.[51]

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[46] Shikaki, op. cit., p 86.

[47] "Egypt, Israel Agree to Buy Atomic Reactors from U.S.," Washington Post, 6 August 1976, p A8; "U.S. Initials Reactor Pacts with Egypt and Israelis," New York Times, 6 August 1976, p D12.

[48] Bhatia, op. cit., p 60; El-Sayed Selim, 1982, op. cit., p 142.

[49] Jabber, 1979, op. cit., p 78.

The AEE published its long-range electricity generation plan at the May 1977 international conference hosted by the IAEA. The plan assumed that a 600-megawatt power plant would prove cheaper than oil-fueled electricity plants after four and a half years operation, and would recover the entire initial investment within ten years of operation. The plan is summarized in Table 8 below.[52]

TABLE 8. EGYPT'S PROPOSED POWER GENERATION FACILITIES

Year Operational	Site	Capacity (megawatts)
1983	Sidi Krier, Unit 1	600
1985	Sidi Krier, Unit 2	600
1989	Upper Egypt Zone	600
1990	El Arish, Unit 1	600
1991	El Arish, Unit 2	600
1993	Cairo Zone, Qattara	600
1995	Cairo Zone	1,000
1997	Upper Egypt Zone	1,000
1999	Cairo Zone	1,000
Total		6,600

What is unusual about this long-range projection is the inexperience of AEE scientists in running a single large power reactor, at the time of the forecast. This implied a significant surge in the number of scientists and technicians undergoing training. It may also have been designed to create an indigenous fuel cycle capability, with military applications.

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[50] "Egypt to Buy French Reactors," Christian Science Monitor, 20 June 1977, p 2.

[51] El-Sayed Selim, 1982, op. cit., p 146; Bhatia, op. cit., p 53.

[52] El-Sayed Selim, op. cit., pp 139-141, taken from K. W. Effat et al, "Projected Role of Nuclear Power in Egypt and Problems Encountered in Implementing the First Nuclear Power Plant," in Nuclear Power and Its Fuel Cycle, volume 6, Vienna: IAEA, 1977.

Egypt's nuclear disadvantage was understood by both President Sadat and Foreign Minister Fahmy throughout the two-year Egyptian-Israeli peace negotiations. Fahmy had demanded full Israeli accession to the NPT as a precondition for peace earlier, in October 1975, January 1976 and April 1976. Sadat repeated the demand in an American television interview 27 February 1977.[53] The Egyptian demand resurfaced in the context of the peace negotiations in the American press in December 1977 and November 1978.[54] Fahmy, a nuclear weapons advocate, resigned after Sadat signed the final peace treaty in 1979. Negotiating from a position of nuclear inferiority may have been his reason, not the idea of peace. Sadat was unable to link Israel's nuclear potential to the final agreement. This is the second indication of Sadat's acceptance of the proliferation status quo versus Israel - Egypt's non-proliferation position.

6. Bureaucratic Decline of the Atomic Energy Establishment

An example of Sadat's exclusion of scientific advice from decision-making in nuclear matters is the 1978 decision to store Austrian nuclear waste in the Egyptian Eastern Desert, allowing Austria full control of the nuclear waste including the right to withdraw it. According to El-Sayed Selim, the AEE was never consulted in this decision.[55] Perhaps this is the result of diminishing the autonomous character of the AEE by placing it within the Ministry of Electricity. The AEE leadership remained under the direction of a scientists since 1970. However the NPPA was headed by a civil engineer. The NMC was headed by a geologist. The dispersion of responsibilities between three organizations does not necessarily signify a diffusion of effort. Funding budgets for these three organizations, if available, might indicate the relative import and size of each organization.

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[53] Feldman, op. cit., p 67.

[54] Perlmutter, Handel and Bar-Joseph, op. cit., p 35.

[55] El-Sayed Selim, 1982, op. cit., p 147.

According to official statements in January 1977, the AEE budget was 585,000 Egyptian pounds (less than $850,000). This was 18 percent of the total budget of the Ministry of Scientific Research and Atomic Energy. Table 9 summarizes this 1977 budget.

TABLE 9. 1977 RESEARCH PROJECT BUDGET,
MINISTRY OF STATE FOR SCIENTIFIC RESEARCH AND ATOMIC ENERGY
(in thousands of Egyptian pounds)[56]

Office of Minister	100	
Academy of Science and Technology	1555	
National Research Centre	790	
Projects of Research Institutes	270	
Atomic Energy Agency	585	
Nuclear Energy and Desalination		(25)
Geophysical Exploration for Fissile Materials		(100)
Programmes of the Atomic Energy Centre (Inchas)		(300)
Programmes of the Radiation National Research Centre		(150)
Programmes of the General Secretariat		(10)

Compared with the AEE budgets in the period 1961-1967, this is a significant decrease in government support. This does not include the NPPA budget, under the Ministry of Electricity.[57] The NMC budget was probably taken from the above budget summary. Insufficient government support for atomic research forced many Egyptian atomic scientists to leave the research field and teach in Arab universities. The Minister of Electricity appealed to immigrant Egyptian nuclear scientists to return to Egypt, but few had returned as of 1981. (According to one study in 1980, 60 percent of Arab researchers worked outside the Arab states.[58]) An AEE official assessed the Egyptian nuclear program in the 1970s as follows:

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[56] Zahlan, 1980, op. cit., pp 83-84.

[57] The Electricity Ministry production budget was 18.5 million Egyptian pounds in budget year 1961/1962. Referring to Table 3, the Electricity sector received four to five times as much investment as scientific research from 1962-1964. Corresponding data is not available for the period after 1970.

> Egypt's scientific base, which has been evolving over the last twenty years, has not been successful in developing and integrating the required specializations. It does not have the capability to implement a self-reliant national program for nuclear energy. Further, the present scientific base has not been fully utilized yet. As a result of the recession of the scientific activities of the Egyptian corporations operating in the nuclear field, growing numbers of experts have emigrated to national universities and Arab countries.[59]

One example of this emigration pattern is Iraq's recruitment in 1975 of Yihya al-Meshad, Dean of Alexandria University Faculty of Nuclear Sciences and Nuclear Reactors, to head the Iraqi nuclear program.[60]

(Egypt continued its scientific connection with India throughout the 1970s. Cairo Radio announced an Egyptian-India agreement for "peaceful applications of nuclear energy," in January 1978.[61] What is not known is the level of technology transferred.)

7. Economic Defense Burden

What do Egyptian military expenditures from 1970 to 1979 indicate about both leadership commitment to go to war and opportunity cost of nuclear weapons development? The Egyptian Israeli peace treaty signed in May 1979 should have lessened hawkish Egyptians security and international prestige incentives to acquire nuclear weapons. Granted the Sinai Peninsula would not completely return to Egyptian control until April 1982, but the treaty raised Egyptian prestige with the West arguably to political parity with Israel. If Sadat had been undertaking a secret weapons program prior to this time, to regain Egyptian pride and Egyptian territory, the peace treaty fulfilled both of those needs with the added bonus of large Western economic and military aid.[62] Egyptian defense expenditures are directly related to perceived security threats and should decline when the leadership perception of security threat has changed. When additional conventional military capability begins to cost more than a nuclear weapons capability, a rational-actor would invest in the nuclear program without retarding conventional force capability. Table 9 summarizes Egyptian conventional force defense burden from 1970 to 1979 and gross domestic investment. Gross domestic investment represents government and private capital investment, excluding government outlays for construction and military durable goods. This approximates the maximum that state and private investors allocated to non-military projects, such as mineral exploration or building new factories. For comparison, the previously cited optimistic 1973 IAEA market survey estimated building a 700 megawatt reactor in five and a half years for $276 million.[63] Other estimates for a base case weapons program (one small bomb per year) are on the order of $200 million over six years, in 1980 dollars.[64]

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[58] Hafez Kobeissi, "Geographic Distribution of Arab Researchers," from A. B. Zahlan, editor, The Arab Brain Drain, London: Ithaca Press, 1981, p 143.

[59] El-Sayed Selim, 1982, op. cit., p 153.

[60] Feldman, op. cit., p 74.

[61] Feldman, op. cit., p 73.

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[62] Robert E. Harkavy and Stephanie G. Neuman, "U. S. Arms Transfer and Arms Control Policies: The Middle East," from Steven L. Spiegel, Mark A. Heller, and Jacob Goldberg editors, The Soviet-American Competition in the Middle East, Lexington Massachusetts: D. C. Heath and Company, 1988, p 28. Military assistance deliveries from the Us to Egypt rose from nothing between 1968 and 1973 to $1.2 million (1976), $20.2 million (1977), $91.7 million (1978) and $283 million (1979).

[63] Kats, op. cit., p 186.

[64] Meyer, op. cit., pp 36-40.

TABLE 10. CONVENTIONAL FORCES DEFENSE BURDEN
(in millions of dollars)

Year	Gross Domestic Investment[65] (base 1975)	Military Expenditures[66] (base 1976/1981)	Per Cent GNP Mil Exp/GNP (Base 1976/1981)
1970	1,531	943	12.8
1971	1,343	982	12.9
1972	1,384	1,197 / 2,423 E	15.1 / 19.2 E
1973	1,997	1,261 / 4,180 E	14.8 / 32.7 E
1974	2,422	1,286 / 4,600 E	14.9 / 35.0 E
1975	3,818	1,056 / 4,447 E	11.3 / 30.9 E
1976	3,273	1,335 / 3,789 E	13.1 / 22.1 E
1977	2,858	1,154 / 4,062 E	10.4 / 21.0 E
1978	2,783	2,978 E	13.9 E
1979	3,056	2,435 E	11.1 E
1980	3,121	2,492 E	10.3 E

E = estimated

The gross domestic investment data give a very broad sketch of Sadat's ability to invest in nuclear infrastructure. The military expenditure per cent of GNP figures show a surge in spending from 1973 to 1977. These data support the contention that if Sadat had access to the advanced technology between 1974 and 1977, he could have supported a six-year, $200 million nuclear development project. Without that western technical guidance, the regime was not sure that the project could be completed.

The period from the Yom Kippur War to the 1979 Egyptian-Israeli Peace treaty exhibits information to support both the weak state and the motivational hypotheses. Evidence to support the weak state hypothesis includes Sadat's creation of the HCNE following a tough pro-nuclear weapons speech, possibly coopting the nuclear "hawks" and distancing the AEE from the regime elites. By firing Heikal soon after a strong public rationale for weapons, Sadat removed a potential political mobilizational tool from the pro-weapons advocates. (This could have been justified to Heikal's supporters by invoking state secrecy laws as well.) Sadat further weakened a possible threat from the AEE by creating the NPPA and the NMC from the AEE as rival organizations, reporting to separate ministries (electricity and trade respectively). The further reorganization of the AEE under the ministry of scientific research in 1976 and again under the ministry of electricity in 1978 shows what a political football the AEE had become by this time. The AEE budget in 1977 compared with the years 1961-1965, is much smaller in relation to total science ministry budget as well as the greater national budget. This declining government support is shown by the emigration of scientists from the research field to teaching or foreign positions.

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[65] World Tables, 1983, Volume I, Baltimore: Johns Hopkins University Press, 1983, p 52.

[66] World Military Expenditures and Arms Trade (WMEAT), 1968-1977, Arms Control and Disarmament Agency, Washington D C: US Government Printing Office, 1979, p 41; and WMEAT, 1972-1982, ACDA, Washington D C: USGPO, 1984, p 24.

The motivational hypothesis is supported by separate Arab leaders' acknowledgement of the Israeli nuclear capability and development of an Egyptian strategic chemical missile deterrent. Also, the reported defense burden of 30-35 percent of GNP from 1973-1975 supports the argument for nuclear weapons as cost effective. London Nuclear Supplier cartel restrictions presents a strongly dissuasive condition from the motivational hypothesis. The global criticism of India after the PNE demonstration in 1974 and Egypt's peaceful reputation from yearly sponsorship of an NWFZ resolution beginning in 1974 have an immeasurable dissuasive effect on the regime.

8. Public Opposition

From 1979 to 1981 the subject of nuclear power was openly criticized for the first time in Egypt. The government's grand announcements prior to this time were not taken seriously by those Egyptian elites concerned with the costs and hazards of nuclear power reactors. The debate centered on six issues: (1) low levels of electricity demand did not justify nuclear power, (2) possible radiation exposure, (3) disposal of radioactive waste, (4) building nuclear power plants too close to large urban centers, (5) furtherance of economic dependency on the west, and (6) danger of Israeli attacks similar to the destruction of the Iraqi reactor.[67] This type of public debate could not have occurred prior to the trend in political liberalization after 1973. That it did not occur until after the Egyptian-Israeli peace agreement may signify that the Egyptian elite did not take Sadat's initiatives seriously until after his peace initiative yielded results two years later.

The proliferation-nonproliferation dichotomy of the Egyptian position towards foreign nuclear exporters is a repeated pattern throughout the period 1975 to 1980. Again in 1979, during the negotiations on the American nuclear cooperation agreement, the talks were suspended after the Egyptians proposed that American safeguards be cancelled in the event of a new war in the region.[68] Perhaps Sadat allowed this Egyptian nuclear hawk faction to express itself even after the peace treaty, in order to extract nuclear guarantees from the US. That he allowed it to continue to exist at all, indicates the possible strength of the pro-nuclear weapons movement inside Egypt even after Heikal was fired and Fahmy had resigned.

In May 1980, Cairo announced the discovery of mineral deposits containing 5,000 tons of uranium and the establishment of a the largest uranium extraction factory in the region, with help from Canada.[69] In July 1980, the Egyptian HCNE declared that the nuclear program was "of vital importance".[70] In September 1980, the new AEE director-general, Dr. Ibrahim Hamouda, gave the following response regarding Israel's suspected nuclear weapons potential:

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[67] El-sayed Selim, 1982, op. cit., pp 147-152.

[68] Bhatia, op. cit., p 60.

[69] Feldman, op. cit., p 72.

[70] Kats, op. cit., p 187.

> As long as a certain state does not make a nuclear test, it cannot be said with certainty that it possesses such a weapon. It is possible to evaluate and assume, but we cannot give a definite answer without proof.

Such an ambiguous response by the head of the Egyptian agency responsible for such activities may indicate that Egypt is not seriously pursuing military applications.[71] Alternatively, this statement carefully satisfies both the nuclear hawks as well as the opponents of nuclear power.

Egypt's sponsorship of the Nuclear Weapons Free Zone proposal in the General Assembly yielded success in the sixth year. The Middle East Nuclear Weapons Free Zone Resolution 35/147 was approved by the UN General Assembly unanimously on 12 December 1980. This was seen as a tremendous breakthrough. The resolution had been approved, slightly modified, in every year from 1974 to 1979, with Israel registering opposition by either abstaining or voting against it. In October 1980 Israel proposed its own version of the resolution and a compromise was reached with the Arab states omitting references to the Egyptian-Israeli peace treaty. This led directly to the Egyptian ratification of the NPT two months later on 22 February 1981.[72] By acceding to the NPT, Sadat had removed the most significant reason holding back the London Suppliers Group from exporting nuclear power plants to Egypt.

9. Sadat's Nuclear Epithet

Sadat used the nuclear weapons debate for political purposes to keep his domestic rivals off-guard. During the period 1973 to 1975, Egypt was most strongly motivated to get nuclear weapons by indigenous development. High defense budgets made nuclear weapons more cost effective, foreign (French) suppliers appeared willing to provide the technology, the conventional military establishment was perceived to be highly professional (not as politically threatening after Sadat reassigned the Chief of Staff as Ambassador to Britain) and almost at the quality of operational parity versus Israel, and the Indian scientific cooperation agreement continued during this period. Yet Sadat's desire for western (American) support required that he subdue the AEE and so he created the HCNE, and then reorganized the AEE to form the NPPA and the NMC in order to keep the AEE from developing the technology independently and threatening the American gambit.

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[71] Bar-Joseph, op. cit., p 223.

[72] Karem, op. cit., pp 92-109.

Estimates of Egypt's technological capabilities by 1981 vary. Egypt's nuclear-technology capability did not mature beyond basic science research to useful applications of that know-how. Sadat redirected the Egyptian nuclear development program from sole reliance on the Soviets to attempted diversification between Western and non-aligned nuclear exporters such as Canada and India. However, the program continued the previous restrictive trends of importing nuclear technology on a "turn-key" basis (dependent on foreign technicians for design and construction) and continued to be entirely financed and directed by government agencies. The long-range plans for 6,600 megawatts of electric power generation by the year 2000, appear overly sophisticated or over-optimistic, according to El-Sayed Selim.[73]

According to one report, Egypt possessed a mature nuclear infrastructure in basic science by the time of Sadat's assassination. Over 500 scientists and technicians were employed at the Nuclear Research Centre in Inchas and at the AEE in Cairo.

> Egypt ranks as one of the scientifically most advanced states in the Arab world. . . . Egyptians are active in international scientific forums and some hold senior position in the IAEA in Vienna. While Egypt has the technological potential to become a nuclear power, it lacks the equipment and resources to implement a sustained nuclear program.[74]

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[73] El-Sayed Selim, 1982, op. cit., p 144.

[74] Pajak, op. cit., pp 42-44.

The weak state model explanation of the eleven years of Sadat's rule gives a partially satisfying explanation for the non-event. The period of highest motivation to develop nuclear weapons is the same period when an additional layer of non-technical elites was created to supervise the civilian and military nuclear development program, the Higher Council for Nuclear Energy (1975). The HCNE in turn over three years divided the Atomic Energy Establishment into three agencies under three separate ministries, the AEE, the Nuclear Power Plants Authority (NPPA), and the Nuclear Materials Corporation (NMC). Whether this was done to retard the weapons program to a non-threatening pace controllable by Sadat or whether it was done to increase the efficiency of the national effort, it effectively weakened the AEE, which had originally included both functions of civilian power applications and raw materials exploration. Foreign Minister Fahmy's support for the weapons applications throughout this period indicates the tension within the regime elites for and against a project begun twenty years previously by the leader of the anti-imperialist revolution.

IV. ANALYSIS

Any weak state, regardless of its motivational disposition and level of scientific advancement, will view a nuclear weapons development project in terms of domestic security as well as international security. If the leader can insulate the scientific community from domestic politics, he may risk supporting the program. Nasir and Sadat repeatedly attempted to insulate their scientific communities from the regime elites. When they each perceived a threat of a new group mobilizing to overthrow the government, they purposely isolated and weakened the atomic development project. If the weak state leader can successfully isolate the scientific community from domestic politics, he will support the program consistently. This type of project required decade-long leadership support for success in past cases of developing states which acquired the bomb, such as India and Israel.

A. MOTIVATIONAL CONDITION

Egypt was increasingly motivated to develop nuclear weapons throughout this study period, for varying reasons. The Egyptian army's defeat in the 1948 Palestine War is the genesis of the Egyptian-Israeli arms race which continued unabated for thirty-three years. Nasir came to power in 1952 largely as a result of that defeat. The spring of 1955 saw the creation of new international security and prestige motivations for Egypt to acquire a future capacity to build nuclear weapons. The Israeli attack on Gaza demanded an Arab conventional force response. Nehru's advice to Nasir, that nuclear technology was a good hedge against international coercion and a source of economic modernization, motivated Nasir to support a nuclear science program. Cabinet secretary

Rahman was strategically placed to favorably influence any elite debate regarding the potential for nuclear weapons. Nasir emerged from the 1956 war vindicated and not threatened by Israel's apparent military superiority.

The December 1960 discovery of Israel's secret reactor, created additional Arab regional pressure upon Egypt to develop a competitive nuclear science capability. The international community allowed nuclear exports to go on relatively unrestrained at that time, except by the state's ability to pay for them. These pressures were relieved by presidential statements that Egypt would protect the Arab world and signs of progress in research and development (a research reactor and an active foreign training program). Salah Hedayat was a nuclear weapons policy advocate within the regime elite in the period 1961 to 1963. Mohamed Heikal took over the role of influential strategic policy expert favoring nuclear weapons after 1965. Egypt's motivational profile does not explain the decision to go public in the fall of 1965 with Israel's ability to produce weapons in three years. Only the dissuasive factor of domestic bureaucratic competition can explain the timing of the direct request for Soviet nuclear weapons technology in December 1965. There was no significant change in Egypt's external security threat or international prestige at that time.

Egypt's loss of the 1967 war provides strong motive conditions - overwhelming conventional security threat, low defense establishment morale, loss in credibility with a nuclear weapons ally, an adversary with a latent nuclear weapons capacity, and delayed domestic turmoil against the regime, after the corrective responses appeared inadequate. Together with these proliferation motives, dissuasive factors included the economic opportunity costs of heavily investing in the AEE, categorized below as domestic politics. The quest for military superiority ceases to be a factor after 1967, until Egypt had developed conventional military parity, so the dissuasive factor of strategic credibility enters in to the equation after 1967.

After the regime consolidation in May 1971, overwhelming Israeli conventional military advantage together with loss of a war appear to be the primary motive elements for all Egyptian foreign policy. From 1971 to 1981 a group within the regime elites voiced its preference for developing nuclear weapons. Military leadership of the Arab confrontation states and Israel's suspected nuclear capability forced Egypt to develop a political answer to the nuclear threat. That answer was alternately to deny its existence or to admit the threat and claim that Egyptian chemical missiles provided the strategic deterrent. The electricity demand for a large power reactor was justified to the IAEA during international conferences on the subject in 1971 and again in 1977. The industrial demand appeared to justify the need for at least one large power reactor, if not six. Low military morale was a strong motive only until the Egyptian army proved its quality during the 1973 war. Afterwards, the military would not have seen the need to have an atom bomb to prove itself a threat to Israel. By the same token, the dissuasive condition of a strategic credibility gap disappeared after the Egyptian military displayed its relative parity in conventional military terms. The higher defense burdens of the 1970s indicate a strong supporting motive for acquiring a nuclear weapon. Also the interruption in foreign patronage between Soviet and American support from 1972 to 1977, deprived Egypt of its' nuclear bomb insurance against Israel's suspected capability. The Indian explosion in May 1974 gave an appearance of global spread to third world states which so alarmed the western european nuclear exporters that they formed a cartel to limit nuclear technology exports. Egyptian scientists must have seen this event as an example to emulate.

The strongest dissuasive factors of Egypt's nuclear motivational profile occurred during the period 1965-1975 are the alliance with a nuclear superpower and the actions taken by both superpowers to prevent Egypt from competing in the regional nuclear rivalry with the same technological assist as Israel had received from the US and the French. The political economic sanctions were a result of that global competition for influence in the middle east. The Egyptian bureaucratic competition is evident between the AEE and the DCA from the period 1965-1971 and again after 1976 with the elevation of the NPPA and the NMC as separate organizations. The domestic politics dissuasive factor is most obvious in the period 1964-1965 and again in 1974-1975. During these two periods, the regime changed the supervisory structure over the AEE, and removed pro-nuclear weapons advocates from threatening positions of political power.

Table 11 summarizes the motivational conditions for nuclear proliferation in Egypt over this period. The politically dynamic nature of nuclear motives is clear. No one motive or dissuasive condition can be described as dominating the others. Also it is difficult to weigh the relative value of motive elements and dissuasive factors at any point in time. The motivational model confirms the presence of a strong motive to acquire nuclear weapons under both Nasir and Sadat. It does not explaining Egypt's nonproliferation. It clearly enumerates the differing types of motives, but does not resolve the result. One must conclude that dissuasive factors outweighed motives by default, using only the motivational model. That does not explain Nasir's direct approaches to buy weapons in 1965 and 1967.

However, this method is useful in presenting the ebb and flow over time, of political motives for and against acquiring a nuclear weapon. Both Nasir and Sadat experienced strong valid justifications for consistently supporting a nuclear development program, during the periods 1961-1970 and 1971-1977 respectively. Yet they did not. Their support was inconsistent at best, the outcome of their struggle to remain in control of a regime which faced multiple domestic political threats from the army and the party during these periods. Both Nasir and Sadat were strongly pressured to go nuclear, by the same conditions which swayed powerful regime elites to voice their stand in favor of going nuclear (Heikal and Fahmy).

TABLE 11. SUMMARY OF MOTIVATIONAL THEORY FACTORS - EGYPTIAN CASE

	Year						
Motive Element	1955	1961	1965	1967	1971	1974	1979
1. Latent Nuclear Threat			X	X	X	X	X
2. Conventional Military Threat				X	X	X	
3. Regional Power Pretension	X	X	X	X	X	X	X
4. Military Imperialism		X	X			X	
5. Domestic Turmoil				X			
6. Industrial Spinoffs	X				X	X	X
7. Low Military Morale				X	X		
8. High Defense Burden					X	X	
9. Loss in Credibility of Nuclear Ally				X	X	X	
10. Global Proliferation Trend						X	
11. Political Elite Proponent	X	X	X	X	X	X	

Dissuasive Factor	1955	1961	1965	1967	1971	1974	1979
a. Nuclear Ally Guarantee			Z	Z	Z		
b. Global Power Preemptive Intervention					Z	Z	
c. Rival with Latent Capacity			Z	Z	Z	Z	Z
d. Domestic Politics			Z		Z	Z	
e. Strategic Credibility Gap				Z	Z		
f. Economic/Political Sanctions			Z	Z	Z	Z	
k. Public Opinion							Z
l. Domestic Bureaucratic Competition			Z	Z	Z		Z
	1955	1961	1965	1967	1971	1974	1979

X = Motive Element Present; Z = Dissuasive Factor Present

B. WEAK STATE EVIDENCE OF THE NON-EVENT

The Egyptian regime's handling of the nuclear development agencies fits an established pattern of undermining state agencies to preserve the state. The dilemma of weak states is that they must mobilize state agencies in order to face genuine domestic or international threats, yet these very same agencies threaten the regime when they become too strong.[1] Nasir first eliminated all opposition within the military and built up a military support base under his loyal friend, Marshal Amer. After seeing the Syrian military coup in 1961, Nasir attempted to control the army under a five-man council. Failing that, Nasir reorganized the mass party, the Arab Socialist Union, as a means of solidifying his regime apart from the army. When the ASU challenged the army in 1965, the ASU in turn became a threat to the regime. Nasir used the army to neutralize the ASU power center during the High Committee for the Liquidation of Feudalism investigation. Sadat faced the same challenges to his leadership from the army and the ASU. He fired army leaders who threatened to become too popular (El-Shazly). He permitted opposition political parties to the ASU and then banned them when they demanded true reforms (New Wafd Party, 1978).

Both Nasir and Sadat used this pattern in their handling of the nuclear development agencies. Scientists initiated the atomic energy program and Nasir appointed a Free Officer to head the national policy-making Board of Atomic Energy. When the scientist Rahman opposed Nasir's unrealistic scientific development plan, Nasir fired him and left a much politically weaker scientist in charge for two years. Hedayat appeared to be the ideal politically reliable, scientist-leader, but his rapid organizational expansion, and his connection with Free Officer elites posed a threat to Nasir. Within a year after sacking

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[1] Migdal, op. cit., p 208.

Hedayat and coopting him as special science advisor, Nasir requested the technology directly from the Soviets. During this time the AEE was first reassigned under one Free Officer and then under Marshal Amer.

Sadat's handling of the AEE is only slightly different. He began by replacing AEE leaders whom he distrusted and then split the agency into separate units. He presided over a period of disagreement over Egyptian nuclear development between regime elites. First before the 1971 coup, he appointed a loyalist to supervise the organization. He retired Hedayat without a sinecure in 1974 after a Libyan-sponsored attempt to overthrow Sadat. Then when the opportunity for foreign assistance from the west improved in 1975, Sadat invoked the danger of the Israeli threat and created the Higher Council for Nuclear Energy for national policy guidance. This is the same year when the previous AEE director-general, a credible scientist with overseas education, was prematurely retired after sixteen years in the AEE. Sadat did not attempt to directly buy the nuclear technology as did Nasir, (perhaps he did not want nuclear weapons as badly as Nasir did). However Sadat fired pro-nuclear advocates for political reasons, and created competing state agencies in the form of the NPPA (1976) and the NMC (1977). These acts weakened the very institutions organized to acquire the technology for both military and civilian purposes. From 1974-1976 Egypt sponsored United Nations resolutions banning nuclear weapons from the middle east and attempted to buy waste-reprocessing technology from the French. Finally Sadat possessed no nuclear guarantee during the five year transition from Soviet client to American client, especially apparent after congressional pressure halted the Nixon reactor sale initiative in 1974. The chemical SCUD-B missile provided the only strategic deterrent.

The weak state model accounts for the interrelationship of domestic security and international security priorities which frame the decision to go nuclear. Nasir appears to have chosen to go nuclear at different times during his regime, when domestic political priorities coincided with international security demands. Sometime in the first half of 1961, after the Israeli Dimona reactor was made public, Nasir enjoyed strong army support and strong pan-Arab support. Later in 1965 the army and the ASU were both a significant threat to challenge the regime's authority. From 1965 to his death in 1970, Nasir's control of the regime was the weakest, and increasing numbers of dissidents were imprisoned. The AEE was secondary to the significant threats to the regime. The AEE as an institution became one small part of the entire bureaucracy which could not enforce government policy decisions upon the society. It was not singled out any more than other state agencies.

Beginning in June 1956, Nasir reshuffled the government cabinets twelve times within fourteen years.[2] Nasir reorganized his government cabinet whenever popular unrest demanded a change at the top of the regime, or whenever he felt threatened by a faction within the ruling elite. Five of those government reorganizations occurred from October 1965 to October 1968, signifying Nasir's weakness before and after the 1967 war. Comparatively speaking, the AEE leadership changes were relatively few, only five (six including Amer) from 1955 to 1968.

Sadat learned from Nasir's failures and did not attempt to buy weapons directly. The domestic and international security priorities appear to support a nuclear weapons program from 1971 to 1977. The army became less of a domestic threat to Sadat after he created a separate internal security force and coopted army leaders or fired them. Sadat weakened the ASU party ideologically and structurally. The regime reversed Nasir's economic isolation from western businesses. Egypt's nuclear guarantee was seriously undermined by the Soviet manner of execution during the superpower nuclear alert in the last days of the Yom Kippor War. Contrary to later Egyptian claims, chemical weapons did not satisfy strategic deterrence demands versus Israel's potential nuclear weapons, if the Egyptian chemical air delivery unit was not deployed for use during the war. Sadat's repression of Islamic protests, military academy uprisings, student protests, and urban workers protests evidence his vulnerability to any group which could mobilize opposition to the regime. This vulnerability explains his demotions of General El-Shazly and Heikal in 1974, as well as his early retirement of AEE chief El Guibaily in 1973 and reorganization of the atomic energy program under three separate ministries from 1975 to 1977.

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[2] Dekmejian, op. cit., p 208.

All of the primary sources of this study, El-Sayed Selim, Moore, and Bhatia provide only sketchy glimpses of the institutional instability of the Egyptian atomic development program during this period. The following chart is a summary of this evolving institution, including the names of the chairmen of the Board of Atomic Energy and the Director-General of the AEE.

TABLE 12. EGYPTIAN SCIENTIFIC AND ATOMIC ENERGY ORGANIZATIONS

Year	Organization	AEB Chairman	AEE Director
1952	Research Council		
1953	National Research Institute (subsumed Research Council)		
1955	Board of Atomic Energy (AEB)	Hussein*	
1955	Atomic Energy Establishment (AEE)		Rahman
1956	Science Council (Rahman)		
1956	National Research Centre		
1959			El Naadi
1961	Ministry of Scientific Research (replaced Science Council)	Hedayat*	Hedayat
1964	Council for Promotion of Scientific Research (AEB/AEE Subordinated to Deputy Premier Rifaat)	None	Unknown
1965	AEB/AEE Subordinated to Marshal Amer		
1965	Supreme Council for Scientific Research	Sait* [Deputy Prime Minister]	El Guibaily
1965-1974	Design Consultants Association (Salah Hedayat)		
1967		Salama [Minister of Education]	"
1968	Ministry of Scientific Research		
1970-1974	Egypt/Libya Federation Minister of Scientific Cooperation (Hedayat)	Mustapha [Minister of Education]	"
1971	National Academy of Science and Technology (replaced Ministry of Scientific Research)		
1973-1976	Board of Atomic Energy attached to National Academy of Science and Technology (El Guibaily appointed Minister of State for Scientific Research)	El Azm	Unknown
1975	Higher Council for Nuclear Energy		
1976	Nuclear Power Plants Authority (Under Ministry of Electricity)		
1976	Ministry of Scientific Research (Subsumed Board of Atomic Energy/AEE)	Effat	Effat
1977	Nuclear Materials Corporation (Under Ministry of Trade)		
1978	Board of Atomic Energy Attached to Ministry of Electricity		
1979	Higher Council for Energy		
1980		Hamouda	Hamouda

* = Free Officer

C. UTILITY OF THE WEAK STATE MODEL

This model does not analyze the technological capability of Egypt to go nuclear. Rather it assumes that Egypt could have developed that technology by 1970 given its initial science base in 1952, with the limited foreign assistance available.[3] Only by access to state secrets could that assumption be properly evaluated. Moore and Zahlan did not have that access but believe that Egyptian scientists have been politically neutered from developing any original scientific research. Judging by the number of prominent Egyptian scientists in the Libyan and Iraqi nuclear development projects, the Egyptian scientists were constrained by the political environment inside Egypt, not by some cultural bias against developing modern ideas.

However this does not discount the utility of the weak state model. Arms acquisitions are a political decision, just as land reform or state education. Domestic politics determines how rapidly a developing state will acquire advanced technologies. Technological capabilities are a necessary condition for nuclear proliferation.

Some questions which would be useful for further analysis of Egypt's case include: what was the level of government funding of both the AEE and the DCA from 1966 to 1972, where did Egyptian scientists train under the Indian-Egyptian nuclear cooperation from 1957 to 1974, who among the regime elites supported the Soviet offer for a power reactor in January 1971? Also, where how did El Guibaily employ foreign-trained scientists upon their return to Egypt? Did Egyptian scientists working for DCA have access to Pakistani research? These questions and others would more closely measure Egypt's technical capability to produce a power reactor and to make nuclear weapons.

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[3] Stephen Meyer estimates that Egypt possessed the technological capacity to develop nuclear weapons by 1969 in Meyer op. cit., p 41.

V. CONCLUSION

A. APPLICATION TO OTHER POTENTIAL NUCLEAR WEAPON STATES

Egypt's case is not a historical aberration. All of the first six states to openly demonstrate their nuclear capability were strong states during the period in which they developed the technology. The weak state model has some explanatory value for the restraints in the process of nuclear nonproliferation. What does this weak-state explanation of Egypt's case imply for other states? Successful development of nuclear weapons requires not only sufficient intentions and sufficient technical capability, but also domestic political strength. State strength is not obvious to outside observers. The state's ability to extract resources and execute policies which require societal compliance need only be strong enough to overcome society's strategies to survive outside the state rules. State institutions are strong in relation to the degree of societal cohesion.

According to Migdal, strong states in the "third world" are a rarity. Newly developing states must first dislocate strong, traditional societies to such an extent that previous methods of social control (feudalism, paternal tribalism) have been destroyed.[4] Iraq's regime from 1970 to the present dislocated its traditional society and created strong state institutions, enabling the regime to survive a crushing military defeat. Iraq's case is unusual though because the state strength is only strong over that part of society which is Sunni Muslim. Resistance from the Shia and Kurdish tribes could spread and weaken the regime's coerced hold on the entire population. While it displayed characteristics of a strong state, Iraq was able to amass the technology sufficient to make nuclear weapons, despite apparent international technological restraints.

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[4] Migdal, op. cit., pp 269-277.

How does a strong state support a nuclear development project? The research effort is functionally diversified by component of the nuclear fuel cycle. True, the various agencies compete with each other for available state resources, but they are not prevented from sharing information informally. The scientific leadership remains accountable to the state, but it is not disrupted by new leadership appointments as frequently. A strong state unifies the atomic effort at the largest practical level. The nuclear project directors in strong states may enjoy the luxury of making slow progress, without threat of unemployment or worse, death. Government nuclear development agencies are also unified to hasten the result, at no threat to the regime. Above all, change in state leadership does not imperil the project. Significantly, the state leader sustains the government investment consistently over an extended multi-year period.

A weak state controls its nuclear development project differently. The state limits participation in the project to those with political reliability. Therefore the project is structured primarily to minimize political risk. The state reorganizes the agency under competing government ministries to hinder the project. The state strictly controls the scientific leadership. The regime removes scientific leaders who are not politically reliable but does not allow them to continue to function in the same capacity outside regime control. They are placed in non-threatening "pasture" positions, as Rahman, Hedayat, and El-Shazly were, or eliminated. The central agency will not share research information with outside agencies including universities - research which could assist the overall effort. Any subunit within the science community which appears to operate independently of state control is divided into competing or functionally diversified agencies. A weak state leadership diversifies the institution to defuse scientific opposition to the regime.

Asia, Africa and Latin America have traditionally been the the focus of American concerns in this subject. After the collapse of the former Soviet Union, other European states are also a concern now. Table 13 applies the three conditions for nuclear proliferation - sufficient motive, sufficient technology and state strength - to all past and selected potential nuclear weapons states. This gives a comparison of how the weak state model works to explain past cases, and a selection of the range of potential future cases. This estimate of present states' nuclear weapons motives, technical capabilities and state strength is a broad generalization, to suggest the applicability of the weak state model. Each individual suspected nuclear weapons state must be studies in detail. Also, because state strength is not static, some present weapon-states have become weaker since they first developed nuclear weapons.

Weak states which may be presently sufficiently motivated and possess the minimum technology, include Brazil and Mexico. Some weak states have not developed the technology yet, but may be close to developing that necessary condition, such as Turkey.

What about the case of Pakistan? Pakistan was a weak state when it developed nuclear weapons. However this outlier case demonstrates the requirement of the weak state to isolate the scientific community from domestic politics. President Ali Bhutto was able to successfully isolate the Pakistani scientific community from domestic political opposition for a sustained period (five years) after Pakistan had developed a considerable scientific latent potential. This was a case of a weak state leader risking his domestic security for the sake of international security priorities. It is interesting that Bhutto survived only seven years in office compared to Nasir's eighteen and Sadat's eleven. Both Nasir and Sadat were more conservative weak state leaders than Bhutto, and they held power longer.

TABLE 13. WEAK STATE MODEL APPLIED TO PAST AND POTENTIAL NUCLEAR WEAPON STATES (NWS)

State	Necessary Conditions		Necessary and Sufficient Condition[5]	
	MOTIVE	TECHNOLOGY	WEAK STATE	STRONG STATE
Acknowledged NWS:				
U.S.	X	X		X
USSR	X	X		X
Russia	X	X	X	
Ukraine	X	X		X
Byelorussia		X	X	
Kazakhstan	X	X	X	
UK	X	X		X
France	X	X		X
China	X	X		X
India	X	X		X
Ambiguous NWS:				
Israel	X	X		X
Pakistan	X	X	X	
South Africa		X		X
North Korea	X	X		X
Potential NWS:				
Sweden		X		X
Germany		X		X
Japan		X		X
Czech Republic		X		X
Argentina		X		X
Taiwan	X	X		X
South Korea	X	X		X
Iraq	X	X		X
Iran	X			X
Vietnam				X
Brazil	X	X	X	
Egypt	X	X	X	
Cuba	X		X	
Mexico	X		X	
Saudi Arabia	X		X	
Syria	X		X	
Turkey	X		X	

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[5] This evaluation of state strength properly requires a detailed study of each state's case. This would produce a rating of state strength on a continuum from extremely weak to extremely strong. It is generalized here for argument's sake.

B. IMPLICATIONS FOR AMERICAN NONPROLIFERATION POLICY

American nonproliferation policy can only influence other state's motives and capabilities. We cannot create strong or weak states. This is a function of internal societal maturity and political conditions leading up to the creation of states.

Nuclear export restrictions directed toward a weak state can slow progress towards the necessary condition of technical capability, as it may have done during the Sadat era in Egypt. International export restraints may have three additional effects on the leader's nuclear development dilemma of balancing domestic and international security priorities. Nuclear supplier export restraints may encourage pro-nuclear weapons scientists to support a counter-coup in order to bring in a new pro-nuclear state leader. Alternately, outside pressure may force the scientists to emigrate to other states where nuclear research is supported by the state. A third possibility is that this foreign pressure will result in the scientific community acceding to civilian-use-only limits on technology imports. We can slow the weak state's development of the necessary technology but there are other possible outcomes which may do as much harm to our cause of restraining the nuclear proliferation process as good. American nuclear nonproliferation pressure must be crafted to widen the gulf between domestic security priorities and international security priorities, to dissuade a motivated weak state from acquiring the capability.

International nonproliferation pressure on strong states in the developing world will be more successful in changing their motives than in changing their technical capabilities. Strong states can develop the technology once they have decided to develop modern industry. The scientific community is not a threat to overthrow the regime in a strong state. The obvious question is how much time is needed for strong states to develop the sufficient condition of technology given the motive to acquire nuclear weapons? This varies with level of state industrialization. India, Israel and South Africa are examples of strong states which developed the technology over differing period of time. Strong states' motivations can be changed by American diplomacy evidenced by the nuclear guarantee to Taiwan and South Korea in 1975. Foreign pressure on a strong state (such as Iran or North Korea presently) will not succeed unless it is directed to change their motive and dissuasive conditions for the weapons.

Foreign pressure can restrain motives, if only in the short run. It cannot restrain technological development. American pressure on Germany, Japan, South Korea and Taiwan has succeeded in temporarily changing their motivational profile using conventional arms supplies, alliances and the defensive nuclear guarantee. This political pressure is a short-term solution to the problem of nuclear weapons spreading to more states.

U.S. policy can be effectively employed against both weak states and strong states. Against weak states, outside pressure can slow technology development. Against strong states, outside pressure can modify the motive conditions for nuclear weapons, but not the technology condition. Nonproliferation policy must be executed with an understanding of these effects and possible outcomes.

A weak state may muddle along for decades until a military confrontation or massive domestic violence forges the society to look to state structures for protection. Or the weak state may experience a revolution which increases society's participation in and ownership of state structures. Until the weak state experiences this catharsis, the domestic threat of a nuclear development program exceeds the international security threat of a rival nuclear weapon state. Nuclear weapons development poses a dilemma which weak state leaders cannot resolve - opposing domestic security and international security priorities.

The conditions which surround the Egyptian nuclear development program from 1952 to 1981, during which time Egypt competed with Israel to develop nuclear weapons and gave up the race, are instructive of the domestic security threat of this highly-political advanced technology. As long as Egypt continues to demonstrate a weak ability to extract resources from and enact policies upon its population, notwithstanding its basic scientific-industrial capacity to do so, Egypt will not develop nuclear weapons. A state's international security motives and technology development are necessary but not sufficient conditions for nuclear proliferation. The necessary and sufficient condition is that the state be a strong state for the duration of the period of the two necessary conditions.

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